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בקשה לפטנט

Application for Patent

100/00774

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אני, (שם המבקש, מענו – ולגבי גוף מאוגד – מקום התאגדותו)
I (Name and address of applicant, and, in case of body corporate-place of incorporation)

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(בעברית) (Hebrew) צעצועים אינטרקטיווים

(באנגלית) (English) INTERACTIVE TOYS

מבקש בזאת כי ינתן לי עליה פטנט
hereby apply for a patent to be granted to me in respect thereof.

° דרישה דין קדימה
Priority Claim

מדינת האגוד Convention Country	תאריך Date	מספר/סימן Number/Mark
PCT	16 ספטמבר 1998	PCT/IL98/00450
ישראל	2 אוקטובר 1998	126444
ישראל	16 נובמבר 1998	127072

° בקשת פטנט מוסף – Application for Patent Addition

° לבקשה/לפטנט to Patent/Appl.

מס' No. _____

מיום dated _____

° בקשת חלוקה – Application of Division

מבקשת פטנט from Application

מס' No. _____

מיום dated _____

° יפוי כח: כללי/מיוחד – רצוף בזה / עוד יוגש
P.O.A.: general / individual – attached / to be filed later –

הוגש בענין filed in case _____

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ת.ד 10256 פ"ת 49002

חתימת המבקש Signature of Applicant

FOR THE APPLICANT,

פנשטר ושות'
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היום This 14 בחודש of דצמבר שנת 1998 of the year

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100/00774

צעצועים אינטרקטיווים

INTERACTIVE TOYS

קומסנס טכנולוגיות בע"מ

Comsense Technologies, Ltd.
c:100/00774

INTERACTIVE TOYS

FIELD OF INVENTION

The present invention relates generally to toys and/or other devices that interact among themselves, especially using acoustic transmissions.

BACKGROUND OF THE INVENTION

US patents 5,191,615 and 4,840,602 describe toys that respond to signals transmitted from a different location. In one example, the signals are RF signals. In another example the signals are encoded light modulations which are carried as part of a TV transmission or as part of a video recording. The disclosures of all the patents and publications mentioned herein are incorporated herein by reference.

US patent number 5,752,880 and a corresponding PCT publication describe toys having a two way communication link with a computer. This link may be used to provide instructions and also to download programming to the toy.

US patent 5,655,945 describes a set of one or more toys that are controlled by a RF signal transmission. The signal is decoded from a vertical blank period signal of a children's movies and the actions of one or more toys (sounds, motion), are synchronized with the movie using the transmission.

However, a child often plays with a plurality of toys and simulates interaction between them.

SUMMARY OF THE INVENTION

One object of some preferred embodiments of the invention is to provide toys which interact directly with each other, preferably enhancing the pleasure of a child playing with the toys. In a preferred embodiment of the invention, the toys comprise action figures, animal figures and/or dolls. Preferably, there is a conceptual relationship between the interacting toys, for example "mother and baby" or "horse and rider", however, this is not required in all the preferred embodiments of the invention.

One aspect of some preferred embodiments of the present invention is related to toys which purposely transmit and receive signals between them. The signals may be part of a complex interaction involving many related signals, for example, confirmations, queries and replies. Alternatively or additionally, the signals may be simple two-part communications, for example toy "A" tells toy "B" to jump and in response toy "B" jumps and/or squeaks. In a preferred embodiment of the invention, the signals are transmitted directly between the toys. Alternatively or additionally, the toys are connected to a communications network. The network may have a star topology, for example, with at least some of the toys transmitting signals through a hub (e.g., a computer). Alternatively or additionally, the topology may allow

toys to forward signals from one toy to the next. In a preferred embodiment of the invention, a signal generated by a toy is intended for a destination toy and may include an indication of that destination toy. Alternatively or additionally, the signals may be multi-cast. Alternatively or additionally, each toy may choose which signals to detect and/or respond to.

An aspect of some preferred embodiments of the invention relates to communication between toys using sounds. Alternatively or additionally to communications using RF; magnetic fields; variable signaling, preferably, low frequency, visible signaling such as by moving appendages; IR; and visible light, toys may communicate using acoustics. In a preferred embodiment of the invention, the sounds used for communications are incorporated in sounds used for play. In one example, one toy generates vocal output towards another toy (talking) and the other toy responds to the vocal output. In a preferred embodiment of the invention, the incorporation is by recognition of the characteristics of the play sound. Alternatively or additionally, the signal is overlaid on the sound as a modulation or appended to it, for example as a beep. Alternatively or additionally, the sounds are inaudible, for example being ultrasonic or infrasonic. Alternatively or additionally, the sounds are inadvertently created when the toy acts, for example, a stomping sound caused by the walking of a first toy may be detected by a second toy, as a signal to respond to.

An aspect of some preferred embodiment of the invention relates to sets of toys that are designed to respond to each other. In a preferred embodiment of the invention, the set includes two, three four or even over ten individual toys. In one example, such a set may include a mother goose and three goslings. When the mother goose quacks and starts walking, the goslings can also quack and start walking after the mother goose. In another example, the set includes a plurality of toy soldiers. Preferably, the soldiers are divided into two groups. Within each group the toys preferably act as a unit, e.g., advance in a synchronized manner. When a soldier from one unit "fires" at a soldier from a second unit, the second soldier preferably responds by shouting out and falling and/or becoming inactive.

An aspect of some preferred embodiments of the invention relates to allowing and generating un-predicted and/or complex interactions between toys. In a preferred embodiment of the invention, each toy receives, transmits and/or responds to signals using a relatively simple logic. However, since there are many toys, with many possible relative positions, relatively simple logic rules may exhibit seemingly complex behavior patterns. In the animal world, such behavior is exhibited by ants, where each ant is relatively simple, but the anthill as a whole exhibits very complex behavior.

An aspect of some preferred embodiments of the invention relates to facilitating interaction between remote players, via interacting toys. In one example, if a first player is

playing with two toys "A" and "B", and toy "A" talks to toy "B", a vocal response for toy "B" may be generated by a second player. In the example of the soldiers described above, one unit of soldiers may be controlled from a remote location, such as another room, possibly using a second player. The control may be exercised by the second player using a computer. Additionally or alternatively, the second player may interact with his toys and this interaction and/or its results being transmitted to the unit of soldiers. In one example, the transmission uses an Internet connection, so that the two players can even be on opposite sides of the world.

An aspect of some preferred embodiments of the invention relates to simple and relatively cheap interactive toys. In a preferred embodiment of the invention, the toys are controlled using a simple micro-controller and communicate using acoustic waves. Such communication is generally significantly cheaper than RF or IR communications. Additionally, such communication does not require a meditating computer, in accordance with some preferred embodiments of the invention, so that software and/or hardware installation on a computer is not required.

It is noted that many electronic devices include a microphone and/or a speaker. In a preferred embodiment of the invention, the microphone and/or speaker are used to communicate with the device. In one example, an acoustic smart card communicates with such a device using sound and/or ultrasound. Such a smart card may transmit information stored thereon. Alternatively or additionally, two electronic devices can communicate, for example a cellular telephone and a PDA, each of which includes a microphone and a speaker. Alternatively or additionally, network may be formed of a plurality of such devices, possibly, with one device forwarding messages from a first device to a second device. In some embodiments, a single acoustic transducer (microphone or speaker) may be controllable to act as both a receiver and a transmitter, by suitably programming the electronic device.

An aspect of some preferred embodiments of the invention relates to interfacing a toy and/or other device with a computer system without installing hardware on the computer. In one example, using a computer having installed thereon a sound card with a microphone and/or loudspeakers, the loudspeakers are used to interrogate an identification device, using ultrasound. In another example, such interrogation is used to determine distance from and/or location of a toy. Preferably, the computer's microphone is used to detect a response from the interrogated device. In some embodiments, especially for toys, the interrogation may comprise audible sounds.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be more clearly understood with reference to the following detailed descriptions of non-limiting preferred embodiments of the invention in which:

Fig. 1 is a schematic block diagram of two interacting toys, in accordance with a preferred embodiment of the invention;

Fig. 2 is a schematic illustration of a mother goose and goslings toy kit, in accordance with a preferred embodiment of the invention;

Fig. 3 is a schematic block diagram of an individual interactive toy figure, in accordance with a preferred embodiment of the invention;

Fig. 4A is a schematic block diagram illustrating two interactive toys, wherein one of the toys is at least partially controlled from a remote location;

Fig. 4B is a schematic illustration of a soldier toy kit comprising two units of soldiers, a tank and an optional command console, in accordance with a preferred embodiment of the invention;

Fig. 5 is a schematic block diagram of a network configuration for toy interconnection, in accordance with a preferred embodiment of the invention;

Fig. 6 is a schematic block diagram of a communications tap for a computer, in accordance with a preferred embodiment of the invention; and

Fig. 7 is a schematic block diagram of a toy network utilizing a central broadcasting station, in accordance with a preferred embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 is a schematic block diagram of two interacting toys, in accordance with a preferred embodiment of the invention. A toy 20 generates a signal which is detected by a toy 22. Toy 22 generates a response 26, back to toy 20. Toy 20 may then generate a further signal, in response to detecting or not detecting response 26. Additionally or alternatively, toy 22 generates a response 28 which is not directed towards toy 20. In a preferred embodiment of the invention, each of toys 20 and 22 comprise individual toys, for example, action figures, dolls, plastic animals and/or toy soldiers. In some preferred embodiments of the invention, the individual toys may be physically coupled together, for example, a plurality of action figures are all coupled to a base plate.

In a preferred embodiment of the invention, signal 24 comprises an acoustic signal. Such a signal may be audible or inaudible, for example being ultrasonic or infrasonic. Additionally or alternatively, the signals may comprise IR, RF, low frequency magnetic fields and/or electrostatic fields. Additionally or alternatively, signal 24 may be a passive signal and/or response to a probe by toy 22, for example an RF probe wave, which is responded to by a frequency doubling.

PCT application PCT/IL98/00450, titled "The Control of Toys and Devices by Sounds", filed September 16, 1998, in the Israeli receiving office, the disclosure of which is

incorporated herein by reference, describes sound actuated toys. In particular, the application describes various sound makers which generate sounds inadvertently as a result of motion, for example beads in a box or crinkle material. In a preferred embodiment of the invention, such a sound maker is connected to and/or mounted on toy 20, so that when toy 20 moves a signal will be generated for toy 22. This PCT application also describes detecting the direction and/or position of a sound, using directional microphones and/or a stereophonic microphone including two or more microphone elements. Additionally or alternatively, a relative distance is determined based on an amplitude of the sound.

In a preferred embodiment of the invention, the sounds (or other signals) are automatically generated by toy 20, for example on a random- or a periodic- basis. Additionally or alternatively, the sounds may be caused by a player, for example by a player activating toy 20.

In a preferred embodiment of the invention, toy 20 comprises a "mama doll" and toy 22 comprises a "baby doll". In a conventional scenario, a child will hold one doll in each hand and generate pretend conversation between them. In a preferred embodiment of the invention, each doll generates conversation sentences in response to conversation sentences uttered by the other doll. The conversation may be initiated by pressing a button on one doll, by their proximity and/or by them being oriented to face each other. In a preferred embodiment of the invention, proximity is detected if one or both toys include a magnetic field generator, such as a magnet, and the other toy includes a switch which is activated by a change in magnetic field. Additionally or alternatively, proximity is detected by a metal part of one toy affecting a resonance circuit in the other toy.

Signal 24 is not limited to acoustic signal. In a preferred embodiment of the invention, the signal (and/or the responses) may comprise control of acoustic signal amplitude and/or frequency, motion, rotation and/or modification of motion and/or rotation of the toy, its appendages or other parts thereof and/or control of illumination, such as blinking of lights.

In a preferred embodiment of the invention, a simple signal-response logic is sufficient, for example a mother cow toy moos and a toy calf doll moves towards the mother. However, in some preferred embodiments of the invention, a more complex logic is provided. Such logic may include one or more of, differentiation between different signals, multiple response, different operations modes and/or states, possibly switched between based on received signals, time duration and response times, detection of responses to a signal, detection of various characteristics of the environment, including number of participating toys and/or absolute and/or relative position and/or orientation and/or distance between the toys.

In a preferred embodiment of the invention, the response is time limited, for example a motion in response to a signal may be limited to 5 seconds and/or to a duration depending on the signal.

In a preferred embodiment of the invention, the logic is implemented by circuits in the toys. Additionally or alternatively, the toys each include a transmitter and/or a receiver and the logic is at least partially if not fully implemented on a computer which communicates with the toys. Alternatively or additionally, other computation requirements of the toys, for example speech signal generation and/or display generation may be performed at the computer and transmitted to a toy for display (visual or acoustic).

In a preferred embodiment of the invention, the detection of a signal by a toy comprises a binary detection of the signal, e.g., an on/off state. Additionally or alternatively, more complex signal detection may be implemented, for example, detection of signal amplitude, frequency, frequency spectrum, Doppler shift, change in amplitude and/or duration, detection of a number of repetitions, voice and/or other pattern recognition in the sound, detecting patters of motion, for example gestures and/or detection of codes, for example in a flashing light source. Thus, the transmitted signal may include information about the sending toy's activities, location, environment, nearby toys, locally sensed information, logic state and/or readiness.

Such signal detection and/or analysis may also be performed on a computer which is in communication with the toys. The physical detection circuit is preferably located on the toy. Additionally or alternatively, the detection circuit is also located on the computer.

Fig. 2 is a schematic illustration of a mother goose and goslings toy kit, which includes a goose 30 and a plurality of goslings 32, in accordance with a preferred embodiment of the invention. In a preferred embodiment of the invention, goose 30 includes a signal generator, for example a sound generator 34. The sound generator may be activated randomly, when activated by a player and/or as a result of goose 30 moving or being squeezed. In a preferred embodiment of the invention, generator 34 is integrated into the legs of the goose so that a "stomping" sound is generated when the goose makes a step. Additionally or alternatively, the sound may be a periodic and/or random "quacking" sound. In a preferred embodiment of the invention, each of goslings 32 includes a sound detector 36. Preferably, the sound detector detects the sound (or other signal) generated by the goose and causes gosling 32 to respond. One possible response is a "quack". Additionally or alternatively, the gosling moves towards the mother goose. Preferably, each gosling includes a sound generator 38, for other goslings to follow. Additionally or alternatively, all the goslings follow the mother goose.

In a preferred embodiment of the invention, sound detector 36 comprises a directional microphone, for example a stereophonic microphone or a microphone in which the frequency response is spatially non-uniform. In a preferred embodiment of the invention, a plurality of microphones are provided on each toy, so that holding the toy will be unlikely to cover all the microphones and deafen the toy. Additionally or alternatively, the microphones are located in hard-to-obstruct locations.

In an alternative preferred embodiment of the invention, the toys comprise puppy dolls, possibly with a mother puppy. In a preferred embodiment of the invention, when one puppy detects that a child is near, for example based on a crinkling bracelet worn by the child, the puppy signals to all the other puppies, for example by barking, and the other puppies approach the child, escape from it, start running in circles and/or otherwise respond to the child.

Fig. 3 is a schematic block diagram of an individual interactive toy figure 40, in accordance with a preferred embodiment of the invention. Toy 40 preferably includes a receiver 42 which receives a signal from another toy. The signal is preferably analyzed by an analyzer 44, to decide on desired responses. An actuator 48 may be used to control one or more motors 46 and/or to send a signal via a transmitter 50. Additionally or alternatively, an acoustic and/or optical response may be generated. Additionally or alternatively, a message may be displayed on a screen which forms part of toy 40.

In a preferred embodiment of the invention, analyzer 44 and actuator 44 are embodied as a micro-controller. In a preferred embodiment of the invention, receiver 42 and transmitter 50 are embedded as piezoelectric acoustic elements, possibly as a single element. In a preferred embodiment of the invention, the output of receiver 42 is amplified to TTL levels and connected directly into one or more data lines of the micro-controller, for analysis. Thus, a high acoustic frequency can be detected and/or analyzed, without requiring an A/D. Preferably, the signal is amplified by various amounts, such as multiples of two of each other and connected in parallel to a plurality of data legs, so that multi-level signal detection is facilitated.

In a preferred embodiment of the invention, a toy kit includes a "dog" figure and a plurality of "sheep" figures. The dog figure moves in the direction of the sheep figures and causes the sheep figures to huddle up and/or move in a particular direction. In a preferred embodiment of the invention, the dog figure includes a memory so that it can track positions from which it "barked" at the sheep figures and/or to store the locations of a plurality of sheep. Preferably, the dog and/or the sheep include a position detection circuit, for example, by detecting a signal transmitted by a base station, for example incorporated in a barn.

Additionally or alternatively, the dog includes a relative motion sensor, for calculating its current position, for example based on motion of wheels of the dog.

In a preferred embodiment of the invention, a plurality of "ant" figures are provided. In a preferred embodiment of the invention, the ants include a proximity detector, so that they can exhibit different behavior if they are near each other or if they are far away from each other, for example whether or not to follow other ants. In a preferred embodiment of the invention, the proximity detection is based on magnetic fields, for example DC magnetic fields or low frequency and/or pulsed magnetic fields. Such fields are generated by a rotating magnet, in accordance with some preferred embodiments of the invention.

In a preferred embodiment of the invention, individual toys may be programmed to specifically respond and/or interact with other specific toys. Additionally or alternatively, the toys may be programmed so that there is an order between the toys, at least an indication of a "leader" toy. In one example, each toy transmits and/or receives at a different frequency band. Additionally or alternatively, each toy transmits and/or receives at a different time delay after detecting a sound. Thus for example in the mother goose embodiment, each gosling may quack back at a different delay after the mother goose quacks. Each gosling may also be programmed to follow a gosling which quacks at a particular delay after the mother goose (0 delay if it is the lead gosling).

Fig. 4A is a schematic block diagram illustrating two interactive toys, a toy 60 and a toy 62, where one or more toys 62 are at least partially controlled from a remote controller 64. In a preferred embodiment of the invention, controller 64 directly controls a signal generated by toy 62 and/or its response to a signal generated by toy 60. Additionally or alternatively, the control may be more subtle, for example, changing a mode of operation of toy 62. Additionally or alternatively, control may be exerted by controller 64 directly generating a signal to toy 60 and/or directly generating a response to a signal from toy 60.

Several dimensions of control are preferably differentiated by all or part of the following analysis:

(a) Is the controller a human, a computer, or a predetermined sequence, such as a tape recording?

(b) Is the control over all aspects/controllable features of the toy or only over some aspects, possibly a single one?

(c) How do the type, extent, amount and/or other characteristics of the control vary over time and/or as a function of interaction between the toys, where such characteristics may vary or remain constant?

(d) Is the control form a nearby location, a line of sight location, a next room or possibly a different city or country?

In a preferred embodiment of the invention, toy 62 includes a remote control, for example a radio remote control. Additionally or alternatively, toy 62 responds to commands from a computer and/or transmissions responsive to a broadcast or a recorded tape. Additionally or alternatively, toy 62 is activated by a player's voice and/or movements.

In a preferred embodiment of the invention, the signals transmitted from toy 62 to toy 60 comprises a command from controller 64.

In a preferred embodiment of the invention, a human player controls toy 62 using a signal generator attached to the player. Such a generator may comprise a bracelet which crinkles. Additionally or alternatively, the generator may comprise a magnetic bracelet. In a preferred embodiment of the invention, toy 62 can detect the relative position and/or orientation of the bracelet and/or motions thereof. In a preferred embodiment of the invention, such detected locations and/or orientations may be used to control an interactive computer game, such as boxing, baseball or golf, whereby hand motions of a computer character are controlled by the motion of the bracelet, a glove and/or a sound maker (passive and/or battery operated) mounted on a play implement such as a bat a club, a steering wheel, a joystick, a sword or a gun. Alternatively or additionally, the motion of the play implement are used to model the motion of a virtual play implement in the game, such as a bat. The motion which is responded to may include, position, motion vector and/or acceleration, in one, two or three dimensions. Five- (or higher) degrees of freedom sensing may require more than one transmitter or receiver on the play implement.

In a preferred embodiment of the invention, the acoustic transducer on the bat (or other play implement) comprises a bendable piezoelectric film, which is bent around the bat, so that the transmission and/or reception is less limited by the orientation of the bat.

In a preferred embodiment of the invention, an action figure responds to these motions in parallel to the computer game, either by directly receiving the motions or by receiving suitable commands from the computer. One or more additional action figures may be controlled by the computer to exhibit the actions of other characters in the computer game.

In a preferred embodiment of the invention, toy 62 is controlled from a remote location. Preferably, signals to toy 62 are forwarded to the remote location. In one example, a child pretends that toy 60 is talking to toy 62. The sound made by toy 60 or by the child is transmitted to the remote location or is naturally audible at the remote location. The voice of toy 62 and/or actions thereof may be provided by a parent in another room or even in another city. In a preferred embodiment of the invention, toy 62 is semi-automatic, so the parent can

decide who responds to toy 60, the parent or toy 62. Preferably, toy 62 delays its response until it is clear the parent will not respond. Additionally or alternatively, the toy is controlled via a switch on the remote control. Additionally or alternatively to a parent, the toy may be controlled and/or may represent a friend of the child, in a remote location, such as the friend's house. Preferably, the friend also has a toy which exhibits the behavior of toy 60. Additionally or alternatively, the friend can view a simulated behavior of toy 60 on a computer screen. Thus, the two children can play together without leaving home.

Fig. 4B is a schematic illustration of a soldier toy kit comprising two units of soldiers 70 and 72, each comprising a plurality of soldiers 71 and 73, an optional tank 74 and an optional command console 76, in accordance with a preferred embodiment of the invention.

In a preferred embodiment of the invention, the soldier toy kit allows an easy play with a large number of individual toys, for example as shown in Fig. 4B. In a preferred embodiment of the invention, each of the individual toys responds to actions and/or movements of the other toys, for example, a toy soldier 73 may repeat any command voiced by any of the other toy soldiers. Additionally or alternatively, the soldiers in a single unit may advance in a synchronized manner, for example all moving together or in a staggered manner. In a preferred embodiment of the invention, the soldiers are wheeled. Additionally or alternatively, the soldiers move using legs.

In a preferred embodiment of the invention, toys from one unit also respond to actions/signals from toys in the other unit. In one example, when tank 74 fires at a soldier 71, the soldier responds by falling and shouting out. Preferably, the soldier detects it is in range by the signal source (such as sound) on tank 74 being directional and soldier 71 being in the direction. In another example, when a soldier 73 moves a soldier 71 advances in response. A directional sound wave may be generated using a suitable wave guide. Additionally or alternatively, two sound sources may be activated in phase, so that they are received in phase substantially only along one line emanating form the sound sources. Alternatively or additionally, a relative orientation of a sound source may be determined using two microphones on the toy. Additionally or alternatively, the sound may be conducted via a floor, with the microphones being acoustically coupled to the floor.

In a preferred embodiment of the invention, console 76 may be used to command individual toy soldiers or groups of toys. Additionally or alternatively, only some of the toys are commanded and those toys generate and transmit commands for the other toys. Additionally or alternatively to using a console, the control may be by voice commands of a player. Additionally or alternatively, the console may be used to provide remote commands, for example from a player in a different house. In a preferred embodiment of the invention, the

console 76 includes a computer, for displaying the relative positions of the toys, their logic, their mode and/or their responses to a remote player or a local player. Additionally or alternatively, console 76 includes a camera for viewing the toys and transmitting their image to the remote location. Additionally or alternatively, console 76 includes a loudspeaker for sounding vocal commands from the remote location.

In a preferred embodiment of the invention, the toys (e.g., their action logic and/or their specificity) may be programmed by computer. Preferably, the programming is downloaded to the toys. Additionally or alternatively, the toys communicate with a computer to perform their logic, so at least for some cases/game scenarios only the computer is (re)programmed. In a preferred embodiment of the invention, at the start of the play the computer interrogates all the toys, to determine which toys are actually in a playing field.

In a preferred embodiment of the invention, spatial angles between a sound source and a plurality of microphones are determined by analyzing phase differences at the microphones. Alternatively or additionally, other methods known in the art may be used. In a preferred embodiment of the invention, a relative location of a pulsing sound source and a plurality of microphones is determined by solving time of flight equations.

In a preferred embodiment of the invention, four microphones are used to determine a three-dimensional position. For a source at $r=(x_0,y_0,z_0)$ and a plurality "i" of microphones at $M_i=(x_i,y_i,z_i)$, the distances between the source and the microphones are $D_i=\|r-M_i\|$. The acoustic velocity, "c", may be known, for example based on a known velocity in air. Alternatively, it may be determined by measuring the time of flight between a sound source and a microphone having fixed and known relative locations. A difference between distances is preferably defined as $dD(i,j)=Di-Dj=c*dt(i,j)$, where $dt(i,j)$ is defined as a difference between time of arrival at microphone i and time of arrival at microphone j. For N microphones there are N-1 independent differences dD. In an optimal configuration, the four microphones located at vertexes of a tetrahedron may be used to determine the location of a source. From practical considerations, such an arrangement may not be possible. Preferably, more than four microphones are used, so that a higher resistance to noise and/or a higher localization precision may be achieved. In a preferred embodiment of the invention, the three dimensional position is determined by numerically or analytically solving three equations of the form:

$dD=c*dt(i,j)=\|r-M_i\|-\|r-M_j\|$, where (i,j) is preferably selected to be (1,2), (2,3) and (3,4). However any other independent three pairs of microphones may be used.

In one preferred embodiment of the invention, a computer loudspeaker, for example as provided with a popular sound card, such as "SoundBlaster" is used to transmit sonic and/or

ultrasonic signals to a toy and/or other object. Preferably, a 20kHz signal is used. In a preferred embodiment of the invention, the object receives the ultrasound signal and sends it back to a microphone of the computer. In a preferred embodiment of the invention, the computer analyses the time of flight and/or other attributes of the transmission and determines a distance from, position to, velocity of motion and/or other spatial attributes of the object.

In a preferred embodiment of the invention, the object responds immediately to the interrogation signal. Alternatively, the object delays its response to an interrogation signal, for example for a few milliseconds. Alternatively or additionally, the object transmits at a different frequency, for example 40kHz. Alternatively or additionally, the signal transmitted by the object is received by a transducer which then transmits the signal to the computer, for example acoustically or using electromagnetic coupling. Alternatively or additionally, the object may respond with an identification code. Alternatively or additionally, the object modulates its transmission with an envelope, which envelope preferable servers as an identification code and/or for transmission of information regarding a status of the object, for example a position of an arm of a toy. In some cases, the object relays information from a more remote object. In the case of identification, the object may send an ID code even without prompting from the computer, for example periodically or by a user pressing a button on the object.

In a preferred embodiment of the invention, the signal received on the computer is used to modify a computer game and/or to generate commands to other toys, preferably using sounds generated by the computer.

In a preferred embodiment of the invention, the object amplifies the signal it receives using a discharge of a coil through a transistor, where the transistor serves as a variable resistor and/or as a wave-form controller.

In a preferred embodiment of the invention, a toy may include a plurality of transmitters and/or receivers (sensors) thereon, controlled by only one circuit. In one example a bendable or deformable toy, such as a boxing glove or a toy train include one sensor on each segment of the toy. Preferably, a multiplexer multiplexes the inputs and/or outputs of these sensors, to reduce the number of channels required of the circuit. The multiplexing may be a time multiplexing. Alternatively or additionally, the multiplexing is a frequency multiplexing, possibly extending to frequency multiplexing in the signals transmitted by a computer with which the toy communicates. Alternatively or additionally, the multiplexing allows a single acoustic element to be selectively used as a transmitter or as a receiver.

In some cases, the microphone and/or the sound card are sensitive enough to receive from the object RF signal associated with generating the acoustic signals, even if an acoustic

signal is not sent. Preferably, frequencies of about 20kHz and 44kHz are used, since a standard sound card has these sampling rates.

Alternatively or additionally, to using a computer, in a preferred embodiment of the invention, a set-top box is used to transmit and/or receive signals. Preferably, a microphone is connected to the set-top box. Alternatively or additionally, the transmission back to the set-top box uses an IR signal, which is detectable by the set-top box. In one example, the set-top box includes software which analyses signals. Such signals may comprise responses of objects and/or toys to sounds generated by the television or by the set-top box. Alternatively or additionally, the set-top box adds sounds to a video and/or audio stream decompressed by the sound box. Alternatively or additionally, the set-top box adds temporal and/or spatial optical modulations to a video stream, for an optically-sensitive toy to detect and/or respond to, for example by moving or generating a sonic or ultrasonic sound.

The set-top box may be used to receive signals and/or to analyze signals for sending to a cable head. Alternatively or additionally, the set-top box includes software for a considerable portion of a game, for example score keeping and/or display update, possibly utilizing a cable head as a storage device and/or as a display-generating slave.

A touch screen in accordance with a preferred embodiment of the invention utilizes acoustic transmission to detect the location of a touch implement, such as a pen. In a preferred embodiment of the invention, the position of the pen is determined using one or more microphones and/or speakers mounted on the pen, which transmit and/or receive signals from a computer and/or other speaker and/or microphone controller. Possibly, a three-dimensional position of the touch implement is determined using four acoustic elements, such as two microphones and two speakers. It is noted that a computer typically includes a modem speaker, an internal speaker and/or a keyboard speaker, as well as sound-card speakers.

In a preferred embodiment of the invention, location methods utilize a calibration process, in which the located implement is placed at one or more known location, so that it is possible to correct for the location of the speaker(s) and the microphone(s)/ Alternatively or additionally, the calibration procedure is used to correct for propagation times (of the acoustic waves and/or of electronic signals which generate sounds) and/or for reflections, wavelength dependent attenuation and/or broadband attenuation.

A different type of touch screen in accordance with a preferred embodiment of the invention detects the location of a touch implement based on the detection and position determination (2D or 3D) of sounds generated when the touch implement touches the "touch sensitive" surface.

Another type of touch screen in accordance with a preferred embodiment of the invention, detects the touch implement based on its occluding beams of ultrasound which crisscross the touch screen. This may require more than one speaker and/or microphone.

Fig. 5 is a schematic block diagram of a network configuration for toy interconnection, in which each connecting line indicates a possible communication path, in accordance with a preferred embodiment of the invention. In a preferred embodiment of the invention, a toy 80 and a toy 82 can directly communicate. Additionally or alternatively, toy 82 and a toy 86 can communicate using an intermediary, for example a computer 84, to which both can communicate. Additionally or alternatively, toy 80 communicate with toy 86 using toy 82 as an intermediary. Preferably, signals from toy 80 include a designation of toy 86. Additionally or alternatively, all messages are multi-cast.

Additionally or alternatively, toy 82 communicates with a toy 90 by computer networking, such as a LAN or an Internet, by which toy 82 communicates with computer 84, which communicates with a computer 88, which communicates with toy 90. Additionally or alternatively, a single toy 86 may communicate with two computers, 84 and 88, possible transmitting messages from one to the other, being controlled by one or both and/or providing status reports to one or both.

In a preferred embodiment of the invention, the toys communicate via acoustic waves, audible or inaudible. Additionally or alternatively, the toys communicate using IR. Additionally or alternatively, the toys communicate using RF signals. Additionally or alternatively, the toys communicate using low frequency magnetic fields. Additionally or alternatively, the toys communicate by telephone, for example, one of the toys being connected to a telephone socket, a cellular phone and/or being in communication with a computer which is connected to such a telephone connection. Such a telephone connection may also be used for a modem dial-up connection and/or for an Internet connection. In a preferred embodiment of the invention, the toy is controllable by DTMF sounds generated by a telephone keyboard, to simplify communication hardware.

In a preferred embodiment of the invention, the signals generated by a toy are inadvertently generated, for example, sounds generated by a wheel rotating or an appendage flapping. Additionally or alternatively, the signals are included in a generated action, for example, a quack sounded by a toy, which may be modulated by a signal, a blinking light, whose blinking may be modified by the signal or a waving gesture which may be modified and/or its duration or amplitude changed, to convey a signal. Additionally or alternatively, the signals are determined by analyzing a response, for example differentiating between different sounds produced by a first toy to decide which sound to make in response. Additionally or

alternatively, the signal may be additional to generated actions, for example, an extra beep after a "quack". Preferably, such additional signals are made as unobtrusive as possible, for example by being ultrasonic.

Fig. 6 is a schematic block diagram of a communications tap 102 for a computer 100, in accordance with a preferred embodiment of the invention. One problem with computer communication is setting up the hardware and software for communications. In the configuration of Fig. 6, a tap is preferably placed on communication line to an existing peripheral 104. Thus, a user may not be required to even access a back part of a computer, let alone a computer's inside. A toy 106 preferably sends and/or receives signals from tap 102. Additionally or alternatively, toy 106 may use one tap for receiving and one for sending.

In a preferred embodiment of the invention, the tap is placed on a cable to a printer, a network cable, a camera cable and/or a SCSI connection. Additionally or alternatively, the tap is placed on a serial cable, for example a mouse cable. Additionally or alternatively, the tap is placed on a modem line, for example on a telephone line or by plugging the tap into another telephone socket, to be received by the modem. Additionally or alternatively, the tap is placed on a game controller line. Additionally or alternatively, the tap is placed on a loudspeaker line. Additionally or alternatively, the tap is placed on a microphone line. Additionally or alternatively, the tap is placed on a display cable line.

In a preferred embodiment of the invention, the tap includes an electro-magnetic coupler, which can induce signals in a cable which passes through or near the tap. Additionally or alternatively, the tap can detect signals in the line and transmit them to toy 106. In a preferred embodiment of the invention, the signals are at a different carrier frequency and/or signal frequency than the usual signals passed along the line. Additionally or alternatively, the signals travel in an opposite direction (input signals on an output line, such as a printer or output signals on an input line, such as a mouse). Additionally or alternatively, the signals encode data which is detected and removed from the data stream in the computer. Additionally or alternatively, the signals are asynchronic on a synchronic line. Additionally or alternatively, the signals are transmitted only when no signal is expected by the computer and/or the peripheral.

In an alternative embodiment of the invention, a piezoelectric actuator (or other vibrating element) is connected to a mouse. The actuator causes the mouse to shake at an amplitude of one or two screen pixels (or less) and the shaking is detected by software in the computer as signals from the toy. A return signal may be transmitted to a tap associated with the actuator, along the serial cable, with the signal preferably being coded to be recognized by the tap and/or ignored by the mouse.

In an alternative embodiment of the invention, toy 106 communicates with computer 100 using a speaker and a microphone of the computer. Preferably, toy 106 receives transmissions from the computer loudspeaker and/or sends signals to the computer microphone. Additionally or alternatively, signals are transmitted to toy 106 via the microphone and received via the loudspeaker, depending on whether the hardware supports such a reverse connection.

In an alternative embodiment of the invention, toy 106 sends signals to computer 102 using a tap which presses keys on a keyboard attached to computer 100. Preferably the key sued is a shift key. Additionally or alternatively, signals from the computer are detected by detecting illumination of LEDs on the keyboard, for example a "Num Lock" LED.

Additionally or alternatively, toy 106 utilizes a transducer which plugs into a parallel port, a serial port and/or is optically coupled or placed near an IR port. Preferably, the transducer is a pass through transducer, through which a printer and/or other peripherals may communicate normally with a computer.

In a preferred embodiment of the invention, the tap and/or transducer can automatically detect which type of cable is tapped/port is connected to. Preferably, such detection is by analyzing amplitude, frequency and/or synchronization of signals passing through the lines. Additionally or alternatively, the computer detects which line is tapped, by detecting particular inferences on that line. Alternatively or additionally, software on the computer sends test signals along the lines, to be detected by the tap.

A computer network in accordance with a preferred embodiment of the invention utilizes sound waves transmitted between computers, using existing hardware, for example an audio card, loudspeakers and a microphone. Preferably, the sound waves are ultrasound waves. In a preferred embodiment of the invention, such a computer network is used to connect a PDA or a portable computer to a different computer, for example for data transfer to or for sharing peripherals, such as a modem, a printer or a storage device. Thus, an existing PDA (which includes a loudspeaker and a microphone) can utilize a modem of a desk-top computer, without requiring additional hardware in the PDA, possibly requiring only a small software change. Alternatively or additionally, such a network may be used in a small office, for example of file or printer sharing.

In a preferred embodiment of the invention, suitable software is installed on computer 100. Preferably, the software is self installing. Preferably, the computer is not used for any other use while toy 106 is communicating with it. Additionally or alternatively, the software can differentiate between "regular" signals" and signals related to the tap. In one example, a provided keyboard driver may detected special codes and/or data sequences on the keyboard

line and remove them from the received data, passing only the rest of the received data to an operating system of computer 100. Additionally or alternatively, a provided mouse driver may detect spurious and/or small mouse movements, and recognize them as being tap related signals. Additionally or alternatively, a printer driver can recognize data on the cable as not coming from the printer but from a tap. Additionally or alternatively, data sent to the tap is preferably sent as data which will be rejected or ignored by the peripheral. Alternatively or additionally, to using a tap for communication with a toy, such a tap may be used to attach a peripheral to computer 100.

An authentication system in accordance with a preferred embodiment of the invention preferably uses a computer for authentication. In a preferred embodiment of the invention, a user may be authenticated by the computer dialing a user's personal communicator (for example a beeper, a cellular telephone, wireless telephone or a satellite telephone) and then listening for a ring of the personal communicator. Preferably, the personal communicator is programmed for a distinctive ring, at least for calls originating from the computer. Alternatively or additionally, a cellular network may instruct a cellular telephone to generate a certain sound, responsive to a request (possibly by computer network) from the computer.

Alternatively or additionally, a user calls up the computer (or the computer calls the user) and the computer performs authentication by transmitting a certain sound to the personal communicator and listening for that sound using its room microphone. Preferably, the sounds are sonic. Alternatively or additionally, the sounds are ultrasonic, for example 20kHz or above. In a preferred embodiment of the invention, the computer uses the detected sound to determine attributes of the personal communicator, for example its distance from the computer.

Alternatively or additionally, to providing a telephone connection, a personal communicator may respond to an ambient room sound (for example an ultrasonic wave or a DTMF tone from a computer) with an ID code. Alternatively or additionally, a user may enter a code into a computer by dialing the code on his personal communicator and allowing the computer to receive the DTMF tones using the computers microphone.

Alternatively or additionally, to a personal communicator, an interrogated ID tag may be used. In some embodiments of the invention, such a tag is interrogated directly using RF, in others, using sound and/or ultrasound (depending on the tag construction). Preferably, the tag is interrogated using a tag-specific code. In a preferred embodiment of the invention, such a tag is used for computer log-on authentication, for example, when a wearer approaches a computer, the computer automatically logs on to that user. Alternatively or additionally, the computer may require the proximity of the ID card in addition to standard log-on procedures. Alternatively or additionally, the computer may periodically interrogate the ID card, to insure

that the card wearer is still nearby. Alternatively or additionally, the computer may interrogate the card for user specific information, for example voice ID or personal information. The computer can thus query the user for a voice response and compare the response (voice print and/or contents) to confirm the card wearer is a designated card wearer. A user can wear two cards, one for general authorization and one including personal information. thus, a computer may interrogate both cards.

In an example of a financial or business interaction over an Internet, one or more of the following three levels of security may be achieved. First, the presence of the card. Second, confirmation of the card wearer using personal information. Third, an identification of the calling computer (which should preferably match the wearer profile and/or information stored on the card). Additionally, it is noted that there exist standard mechanisms for transmitting sound over an Internet (or a telephone line). Thus, sonic or ultrasonic communication, for example from a smart card or an ID card may be practiced over a telephone connection or over an Internet connection. These communications may include coded communications, for example using the RSA encoding or other public-key algorithms. Alternatively or additionally, the communications may use DTMF tones. Alternatively or additionally, such communications may be used for telephone calling cards. Alternatively or additionally, such communication may be used for transmitting credit card information. In a preferred embodiment of the invention, a credit card includes a sound output (optionally encoded). Thus, a user can "swipe" his card at any electronic device which includes a microphone (optionally a speaker, for two way communication) and suitable software/hardware, for example a home computer.

Such a smart card may utilize a single piezoelectric transducer (possibly a film) for both transmission and reception. As many electronic devices include a speaker and/or a microphone, such a card may communicate with any such device which has suitable software. Alternatively or additionally, such electronic devices may communicate between themselves, for example a PDA with a printer. Possibly, such communication is used to exchange data files and/or to share capabilities, such as modem connections. In some cases an adapter, for example sonic to parallel may be required.

In a preferred embodiment of the invention, such an acoustic communication may be used to program a toy and/or retrieve information from a toy, for example replacing an RF link as described in US patent number 5,752,880, referenced above. Alternatively or additionally, such a link may be used for real-time communication with the toy.

In a preferred embodiment of the invention, sonic and/or ultrasonic communication is used for paying a toll (human, package or vehicle), utilizing a smart card, possibly a passive

transponder, on the tolled item. Alternatively or additionally, an acoustic mechanism is used to open vehicle barriers, for example at entrances to apartment complexes or to open garage doors. Alternatively or additionally, the acoustic mechanism is used for automatic refueling systems, possibly transmitting billing and/or mileage information to a pump receiver. Possibly, the car horn or an alarm speaker is used to sound the required sonic and/or ultrasonic signals.

In another example, a smart card is used to operate arcade games. Such a card may utilize the speaker and/or microphone of the game. Alternatively or additionally, the card may include information about the user, for example for billing. Alternatively or additionally, the information may include gaming information, for example how far in the game the player is or player level, so the arcade game can be suitably configured.

It should be noted that such an acoustic smart card may also be used as a customer card, since information about the card holder can easily be retrieved from the card.

Such acoustic communication may also be used to communicate between a play implement and a computer game, for example between a sword and a play station. In one example, a light-pen or a light-gun transmits to the playstation a signal responsive to pixel intensities which are detected by a photo-detector thereon. Alternatively or additionally, a synchronization signal is transmitted from a computer and/or a set-top box to the pen, to synchronize the pixel detection with the TV raster scan. These transmissions may be additional to- or alternative to- transmission of position and/or orientation. Alternatively or additionally, the play implement transmits the status of controls thereon. Alternatively or additionally, the transmission is used to transmit information to be displayed on the implement, for example to light up lights thereon, display a number of kills thereon and/or drive text and/or graphics displays thereon.

A software protection method in accordance with a preferred embodiment of the invention comprises a passive ID tag which responds to a query. In one example, such a tag is attached to the case of a software CD, such that the software will operate only if the computer on which it runs can query the CD for a particular code, using ultrasonic or sonic signals. Alternatively or additionally, the ID tag may be attached to the CD itself and/or attached to (or integrated with) an implement used for interacting with the software, for example a toy implement. Alternatively or additionally, the tag may be permanently attached (such that removal will damage it) to the case and/or monitor and/or other internal or external element of the computer.

Fig. 7 is a schematic block diagram of a toy network utilizing a central broadcasting station 114, in accordance with a preferred embodiment of the invention. In a preferred embodiment of the invention, a toy 110 may be controlled by central broadcasting station 114.

In a preferred embodiment of the invention, station 114 is a DAB (Digital Audio Broadcast). Additionally or alternatively, station 114 is a cable broadcast or and Internet broadcast. In a preferred embodiment of the invention, toy 110 comprises a quiz toy which receives the quiz questions from station 114 and interacts with a player. In a preferred embodiment of the invention, a second toy 112, possibly at a remote location is also controlled by the same or related broadcasting station. Thus, toys 110 and 112 may be operated in a synchronous manner, for example, both asking the same quiz questions or questions selected from a same question set, at the same time. In a preferred embodiment of the invention, the toys include a communication feedback to station 114, the feedback indicated by dotted lines in the figure. In a preferred embodiment of the invention, station 114 receives from the toys an indication of progress of the quiz, a number of correctly answered questions, an identification of the toy or its owner and/or other information related to the particular quiz, a history of playing and/or the player. In a preferred embodiment of the invention, station 114 broadcasts to the toys an indication of a winner of the quiz and/or other statistical information relating to the plurality of players simultaneously playing the quiz. In one example, the name of the winner is broadcast. In another example, a signal is broadcast so that only the winner toy will say "I am the winner".

In a preferred embodiment of the invention, each toy comprises a receiver for receiving the DAB broadcast and decoding information stored thereon. Preferably, the feedback is provided by a telephone connection from the toy. Preferably the feedback connection is used only if the toy is the winner or in the case of other infrequent occasions, so as not to tie up telephone lines. Additionally or alternatively, the feedback is meditated by a computer with which the toy communicates.

Additionally or alternatively, in cable broadcasting embodiments, the feedback connection may be via cable modem. Additionally or alternatively, in Internet broadcasting methods, the feedback may be by e-mail or by TCP/IP.

Various examples of preferred embodiments of the invention will now be described.

In a preferred embodiment of the invention, a following toy is provided, in which the following toy preferably follows sounds made by a human while the human is walking, for example footstep sounds. Alternatively, the toy follows sounds from a device on the human. Alternatively, the toy moves away from the human. In a preferred embodiment of the invention, the sounds are programmed into the toy. In a preferred embodiment of the invention, when a stomping or other programmed sound is detected by the toy, the toy cringes, as if stepped on and/or displays other changes in its activity. In one example, the toy has a shape of a spider, with the legs being supported inside the body of the spider using a string.

When the spider [redacted]es, the string is released and the leg[redacted]llapse. Alternatively or additionally, to responding to foot steps, a toy may be programmed to follow and/or respond to clicking at a keyboard, a telephone ringing and/or other sounds. In a preferred embodiment of the invention, the toy is programmed by a user, for example by subjecting the toy to a sample sound. Thus, such a spider can be programmed to recognize foot steps of a particular individual.

In a preferred embodiment of the invention, a hugging follower toy is provided, for example in the form of a panda. When the panda catches up with the object it is following, for example a child, but also possibly another toy, the panda preferably hugs the object. Preferably, the distance to the followed objected is determined as described herein. Alternatively, a contact determination is made. Alternatively, the determination utilizes a static-electricity charge on the followed object.

Alternatively or additionally, a following toy may respond differently to different sounds, thus appearing to participate in a multi-player game. In one example, a dog may follow players around and jump up at a ball, when the ball hits a floor or is caught.

In a preferred embodiment of the invention, fighting action figures are provided, in which an action figure, for example a "ninja turtle", responds to actions of a player, for example waving a hand when the player waves a hand. Preferably, the figure responds to sounds generated by sound-makers on various portions of the player's body. Alternatively or additionally, weapon toys respond to sounds made by the player, for example, a bow may release an arrow, responsive to a certain sound.

In a preferred embodiment of the invention, a flipping toy is provided. Preferably, the flipping toy includes two or more sides. When the toy is "startled" with a particular sound, the toy files, to display a different side. In one example, one side is a happy animal and the other a snarling animal. In another example, one side is a camouflaged soldier and the other a non-camouflaged solider. Optionally, each side transition requires a different startle sound, for example one for the solider to become camouflaged and one for the solider to show himself. In a preferred embodiment of the invention, the toy flips by suddenly shifting an internal weight, for example using an electric motor or a solenoid. Alternatively or additionally, to flipping, the toy may change position between a small number of fixed positions, for example, standing and sitting.

In a preferred embodiment of the invention, a moody animal, for example a dog is provided. When the dog is "hungry" it snarls and/or displays other attributes of a certain behavior. When toy food is thrown to the dog (identified for example by a sound generated by

the food), the dog changes its mood and/or goes to the food and/or different location in the room, for example a food box. In one embodiment, the food comprises a marble.

In a preferred embodiment of the invention, a toy animal is controlled using sounds generated by a telephone. In one example, the telephone is used to call into a computer and the computer detects sounds from the telephone, for example DTMF sounds. In another example, a computer and/or a toy can respond to DTMF tones generated by a telephone handset, a wireless telephone, a cellular telephone or even a play telephone.

In a preferred embodiment of the invention, a baby mobile responds to sounds made by a child, for example changing its speed, direction of motion, distance of moving elements from a baby and/or other attributes of the mobile. In one example, a mobile comes closer to the baby when the baby is quiet and retreats when the baby makes a load noise.

In a preferred embodiment of the invention, a multi-part toy is provided, in which the parts attempt to follow each other. In one example, the multiple parts comprise portions of a caterpillar, with each part trying to catch the other parts. Preferably, the parts follow each other in order. In this embodiment, it may be an advantage if the parts cannot follow exactly. Preferably, if a caterpillar part catches up with another part, the parts connect together at their point of contact, possibly disconnecting a short while later. Possibly, the caterpillar starts moving only upon hearing a certain sound. Possibly, the tracked sounds is generated by a movement rustle and/or by a sound generated inadvertently by a motor which generates the motion. In another example, a shell of a turtle attempts to catch and/or enclose a turtle (without a shell). In another example animal catchers, possibly with nets, attempt to close in on an escaping animal. In another example, a plurality of soccer player figurines (or action figures) attempt to catch a ball. Possibly, some or all of the figurines may be controlled by sounds made by a human player. Alternatively or additionally, the figurines respond to sounds made by the ball and/or other soccer players.

In a preferred embodiment of the invention, a plurality of figurines are provided, each of which responds to a different musical note. Thus, when music is played (recorded or live) the figurines "dance" to the music. As described herein, a complex logic may be defined for sound responsive toys, for example, the toy may respond differently if it is still in motion when it hears a same note a second time.

In a preferred embodiment of the invention, computer games are provided in which a computer display responds to external sounds.

In a preferred embodiment of the invention, a bowling game is provided, in which a computer detects sounds generated by a moving bowling ball and knocks over pins on a display. Preferably, a soft ball is used. preferably, the motion of the ball is determined relative

to the computer microphone and/or speakers, as described herein. Alternatively, an independent sound generator and/or receiver may be utilized, which sound element is preferably integrated with a computer using minimally-installed hardware, as described herein.

In another example, a computer displays a thrown ball, for example a baseball and determines a "hit" based on detected motion of a baseball bat. In another example, a computer goalie attempts to stop a real ball kicked by a player. The position and/or other motion attributes of the ball are preferably determined by acoustic distance determination using only the hardware already installed in a standard computer, for example as described herein. In another example, a boxing match a computer tracks motion of a glove, to detect hits on a computer figure and/or to emulate evasive maneuvers. Alternatively or additionally, the computer tracks motion of the player, to aim its own punches and/or to asses a score. Optionally, the computer is used to display motion of a second remote player. Alternatively or additionally to boxing, the computer may track motion of sources (preferably with implanted sound devices or with a wrist band sound device). Alternatively or additionally, the computer may track positions and/or alignments of toy guns and/or of players holding the guns. Possibly a map of a room may be provided so the computer can determine if a gun has a line of site in the particular room.

In a preferred embodiment of the invention, a horse race is provided, in which progress in the race is generated responsive to movements of a player, sounds generated by spurs and/or sounds generated by a toy horse whip.

In a preferred embodiment of the invention, a set of playing blocks is provided, when a user moves a block, the computer detects the motion and preferably identifies the block. The computer preferably responds to the motion by stacking and/or un-stacking corresponding virtual blocks on a screen. In a preferred embodiment of the invention, only a small number of real blocks are provided. Possibly each time a block is mock stacked, a new virtual block is created and stacked. Possibly, a user may include voice commands, for example "drop". Alternatively or additionally, to blocks, other structural elements may be controlled.

In a preferred embodiment of the invention, a "Simon says" game is provided. In one example, a computer generates vocal instructions to a player and then tracks the players position and/or motion, to determine if the instructions are complied with and/or to score. Possibly, a single computer can track a plurality of players simultaneously. Alternatively or additionally, the computer may include a figure, for example a "Barney" figure, which responds to motion of players, for example as in a "following the leader game". In a preferred embodiment of the invention, a virtual action figure in a computer game may respond to

sounds generated by a user, for example by growing. Possibly, if the figure grows too much, it pops and shrinks or "dies".

In a preferred embodiment of the invention, a computer per is provided. the pet may be a virtual pet or a real pet. In a preferred embodiment of the invention, the pet responds to sounds generated by the computer, for example advancing, retreating and/or licking the computer. In a preferred embodiment of the invention, the pet can be trained by a user, to respond to certain sounds. Alternatively or additionally, the computer "talks to the pet, especially when the pet is in the vicinity of the computer and/or responsive to weather the computer is in use (e.g., being type on) or not.

In a preferred embodiment of the invention, a computer generated figure responds to actions of a user. In one example, a stretch figure distorts itself in response to motion and/or sounds made by a user. In one example, moving an arm causes the figure to stretch its arm to a greater length.

In another example, when a user makes an animal sound, an animal figure appears. Alternatively or additionally, a user can emulate an animal, by the computer generating scenery appropriate for the animal (e.g., seascape, land, mountains) and then changing the scenery responsive to motions of the person (e.g., swimming, walking, wing flapping). Alternatively or additionally, the animal which appears interacts with the player, for example responding to sounds or movements.

In a preferred embodiment of the invention, the number and/or quality of sound generating devices and/or sound receiving devices is improved so that a virtual realty suit is provided. An example of improved quality is providing narrow bandwidth sound generators and/or transponders. Typically, a high quality is not required for games to be realistic and may not be economically feasible, however, a high quality may be desired. Such a suit generally enables a computer to track the motion of part or all of a body to a high accuracy and to generate imagery which incorporates the existence of the suit wearer. Typically, the imagery is displayed to the suit wearer. Such a suit preferably also includes feedback elements, for example piezoelectric vibrators, which provide feedback to a suit's wearer from objects in the virtual world.

Attention is directed to "Appendix A", the disclosure of which forms an integral part of the present specification, in which, inter alia, details of various toys and/or hardware for sound responsive toys are described. These details may be usefully applied in some of the above described preferred embodiments of the invention.

The present invention has been described in terms of preferred, non-limiting embodiments thereof. It should be understood that features described with respect to one

embodiment may be used with other embodiments and that not all embodiments of the invention have all of the features shown in a particular figure. In particular, the scope of the invention is not defined by the preferred embodiments but by the following claims. Section titles, where they appear are not to be construed in limiting subject matter described therein, rather section titles are meant only as an aid in browsing this specification. When used in the following claims, the terms "comprises", "comprising", "includes", "including" or the like means "including but not limited to".

CLAIMS

1. A toy kit comprising:

a leader toy which generates acoustic signals; and

at least one following toy which receives the acoustic signals and utilizes the signals to follow movements of the leader toy.

2. A kit according to claim 1, wherein said at least one following toy comprises a plurality of following toys.

For the applicant,

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c:100/00774

ABSTRACT OF THE INVENTION

A plurality of individual toys, at least a first one of which generates acoustic signals and at least a second one of which receives acoustic signals. When the second toy receives acoustic signals from the first toy, it responds, for example, by generating a sound and/or controlling its motion. In a preferred embodiment of the invention, the toys flock and/or form a procession of toys which follow a leader toy, for example a mother goose and a plurality of following and preferably quacking goslings.

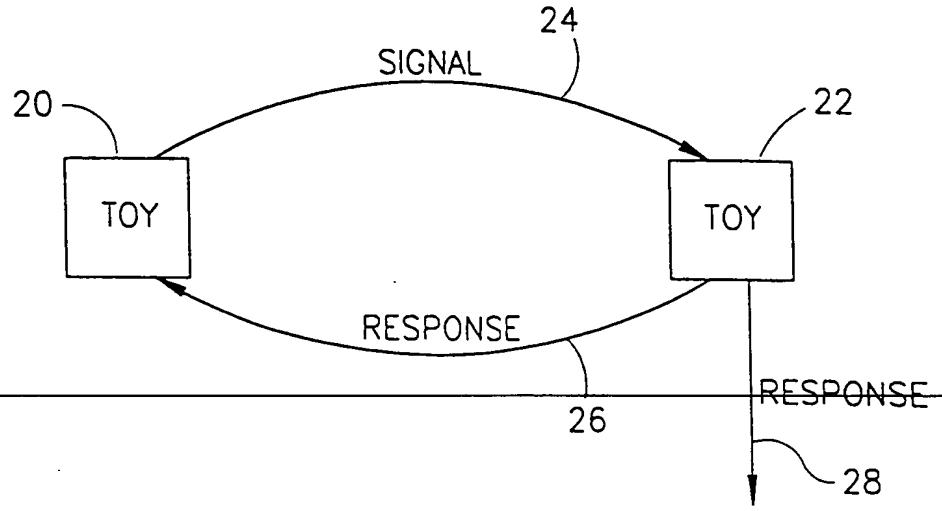

FIG.1

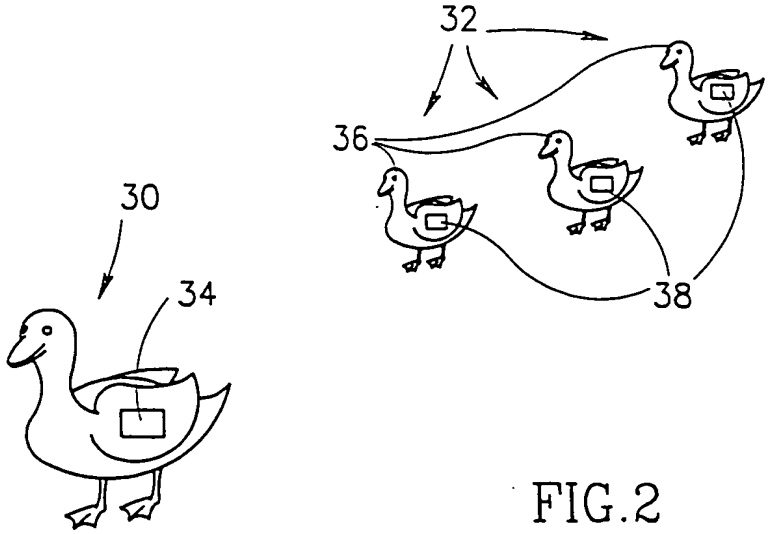

FIG.2

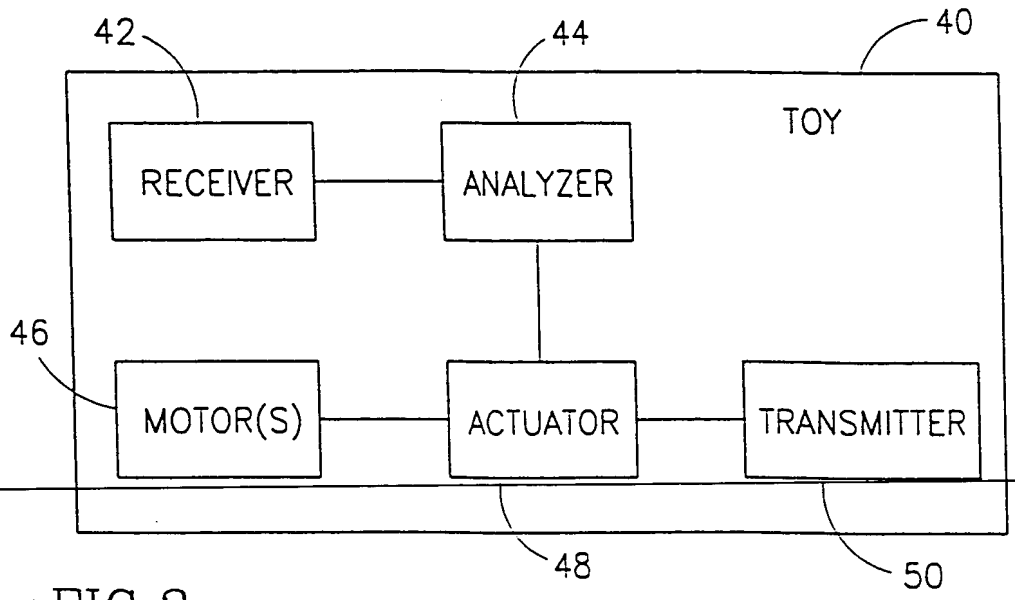

FIG.3

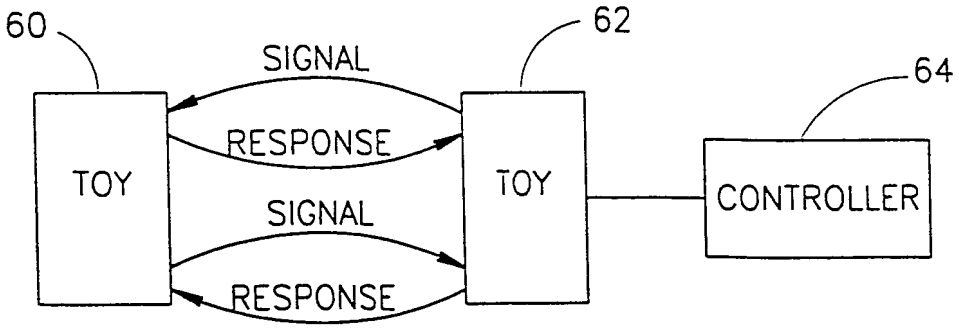

FIG.4A

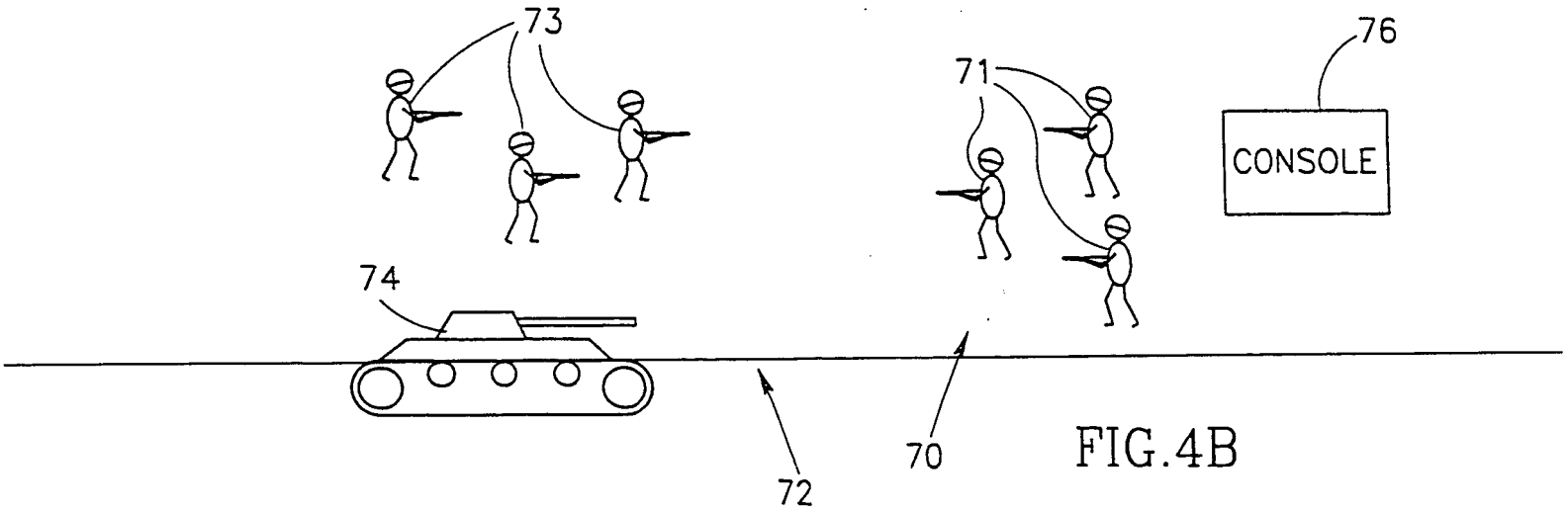

FIG.4B

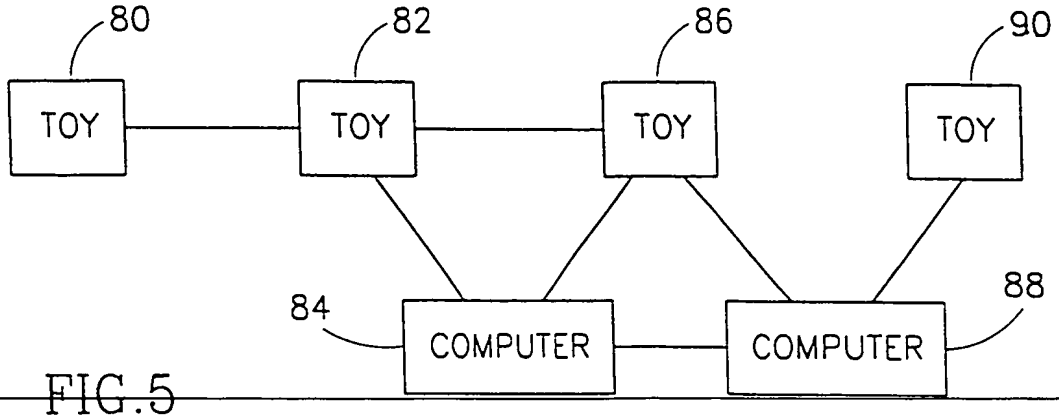

FIG.5

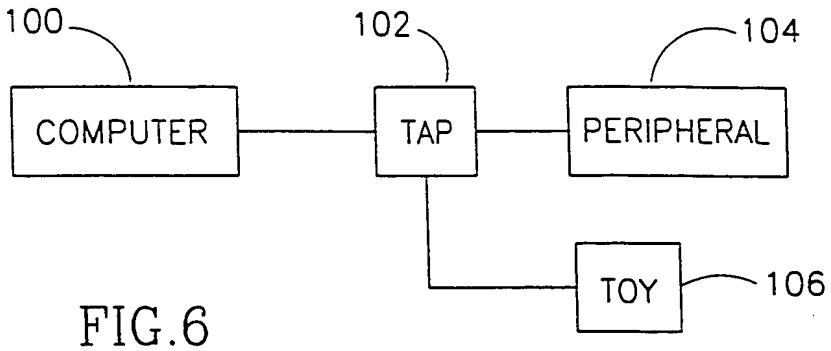

FIG.6

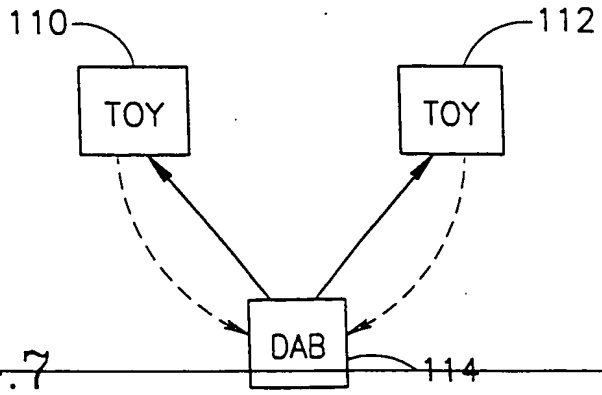

FIG.7

THE CONTROL OF TOYS AND DEVICES BY SOUNDS

FIELD OF INVENTION

The present invention relates generally to the control of toys and devices by sounds, as well as to the control of toys and devices by incidental sounds, that is by sounds whose generation is subordinate to some other action, or by sounds whose generation accompanies some other action.

BACKGROUND OF THE INVENTION

Devices that perform certain functions in response to sounds such as singing, whistling, ringing bells or voicing commands are known in the art. These devices are used, for example, in toys and appliances.

US 5,209,695, "Sound Controllable Apparatus Particularly Useful in Controlling Toys and Robots", the disclosure of which is incorporated herein by reference, describes an apparatus for controlling a device according to different sound commands. The apparatus comprises a microphone, a processor and a control system. The apparatus is capable of interpreting different commands, which may be a word, combinations of words, beeps, hand-claps and whistles.

US 4,673,371, "Robot-Like Toy Vehicle", the disclosure of which is incorporated herein by reference, describes a robot-like toy that reverses the direction of its movement in response to a loud sound, such as a hand clap, or a call.

US 4,231,184, "Remote-Control Doll Assembly", the disclosure of which is incorporated herein by reference, describes a doll that raises its arms and cries in responds to sounds made by squeezing a toy baby bottle or by squeezing a pressure-sensitive rattle.

US 4,637,007, "Toy having a Melody-Making Mechanism of a Sound-Detection Type", the disclosure of which is incorporated herein by reference, describes a toy such as a stuffed doll, having a melody-making mechanism which responds to external sounds such as human voice or a hand clap.

These sound-control devices rely on sounds generated by a specific action of the user, for example, by pronouncing a word, clapping hands or squeezing a pressure-sensitive rattle.

US 4,973,286, "Multiple Activation Crib Toy", the disclosure of which is incorporated herein by reference, describes a crib toy that provides musical output and predetermined motions of a plurality of cartoon-like figures. The crib toy contains several noise-producing apparatuses (a rattle, a horn button and a center button) that are an integral part of the crib toy. The crib toy is activated by sounds. The sounds may be ambient sounds or specific sounds produced by an infant manipulating the noise-producing apparatuses.

US 4,207696, "Sound Activated Mobile", the disclosure of which is incorporated herein by reference, describes a mobile that is activated by the sounds in its vicinity.

US 4,640,034, "Mobile for Infants", the disclosure of which is incorporated herein by reference, describes a sound-producing mobile and cassette player that are activated by sounds from the crib, and respond with comforting voices via a loudspeaker and movement of the mobile.

These sound-control devices rely on ambient sound which may come from the baby, but may come from other sources as well, so their response is not necessarily specific to the baby.

Toys that respond to other toys are described for example in the above described US 4,231,184, "Remote Control Doll Assembly" and US 4,973,286, "Multiple Activation Crib Toy". US 5,314336, "Toy and Method Providing Audio Output Representative of Message Optically Sensed by the toy", the disclosure of which is incorporated herein by reference describes a toy capable of optically detecting and recognizing specific markings on objects, and articulating a word, a phrase or a sentence in response to the markings. In this way the toy may "read" and "speak". The markings may be visible codes, invisible codes or holograms.

Toys and devices that respond to sounds by body motion are described for example in US 4,984,380, "Body-Motion Activated Crib Mobile", the disclosure of which is incorporated herein by reference, describes a mobile that is activated by an infant's motion, utilizing a passive infrared sensor detects the body motion.

Toys that respond to a direction a sound are described in US 5,407,376, "Voice-Responsive Doll eye Mechanism", the disclosure of which is incorporated herein by reference, which describes a doll having a mechanism that provides eye rotation when a child speaks to the doll, to simulate a human response.

SUMMARY OF THE INVENTION

One aspect of some preferred embodiments of the present invention is to control toys and electrical devices by incidental sounds produced by a sound maker that is attached to a person, a pet and/or devices physically coupled to a person, such as clothes or a wheelchair.

In preferred embodiments of the invention, a sound maker is worn by a person or a pet, or is attached to an article of clothing of the person. As the person (or pet) moves, sounds incidental to the movement are generated. The responding toy or device has a microphone and appropriate circuitry to respond to the incidental sounds. Examples are, an infant wearing a rattle bracelet may operate a mobile, an invalid wearing a rattle pendant may operate lights and

electrical appliances such as a radio, and a fan, a pet wearing a rattle collar may operate an electric door lock, or an electric water faucet.

An aspect of some preferred embodiments of the present invention is to provide toys and devices that respond to the direction of a non-human sound source, or to some other direction with respect to the direction of a sound source (wherein the sound may or may not be incidental).

In preferred embodiments of this aspect, the responding toy or device has a stereophonic receiver (comprising two microphones) and appropriate circuitry to discern the direction of a sound source and to respond in proper manner Alternatively, the responding toy or device has a receiver which comprises a single microphone that has an angular-dependent frequency response, so that sounds from different directions are received differently. For example, a toy puppy may respond to a sound source by turning and looking in the direction of the sound source. Alternatively or additionally, the toy puppy may also walk towards the sound source and/or change its direction of motion. In another example, a toy car may wheel over towards the sound source. Alternatively or additionally, the toy may respond to the sound by changing an angle of at least one of its wheels. Alternatively or additionally, the toy may respond to the sound source with a different logic, for example, turn away.

An aspect of some preferred embodiments of the present invention is to provide toys and devices that respond responsive to a distance of the sound source. In one example, a toy responds only to sounds within a specific distance, or respond differently to sound sources from different distances (wherein the sounds may or may not be incidental).

In a preferred embodiment of the invention, the responding toy or device include a range finder. For example, a radio and a fan will be turned on only when an invalid wearing a sound maker is within a specific range.

An aspect of some preferred embodiments of the present invention is to provide toys and devices that respond responsive to a change of direction and/or distance and/or relative or absolute position of the sound source. In a preferred embodiment of the invention, the response may depend on the magnitude of the change and/or on the polarity of the change, for example, advancing/retreating (wherein the sounds may or may not be incidental).

In preferred embodiments of this aspect, the responding toy or device has appropriate circuitry to determine whether a sound source is approaching or moving away by the different levels of amplitude with time. For example, as the sound source approaches, the sound amplitude increases. Alternatively or additionally, the responding toy or device has appropriate circuitry that relies on the Doppler effect of the sound frequency to determine whether a sound

source is approaching or moving away. For example, a doll may say, "Hello," when a toddler wearing a rattle bracelet approaches, and "See you later," when he walks away. An "I-am-always-behind-you" puppy may follow close behind the toddler. A "chase-me" ball may roll away from the toddler. In a preferred embodiment of the invention, an incidental sound source is constructed to provide a substantially constant amplitude and/or frequency spectrum substantially independent of the cause for sound generation.

An aspect of some preferred embodiments of the present invention is to provide toys and devices that respond differently to different amplitudes of sound (wherein the sound may or may not be incidental).

In preferred embodiments of this aspect, the responding toy or device has several amplitude filters and appropriate circuitry to respond in kind to different amplitude levels. For example, a mobile or a toy computer may play a loud tune in response to a loud rattle and a soft tune in response to a soft rattle.

An aspect of some preferred embodiments of the present invention is to provide toys and devices that respond differently to different pitches of sound wherein the wavelength of the sound is known or wherein the sound have a known wavelength spectrum. (The sound may or may not be incidental).

In preferred embodiments of this aspect, the responding toy or device has a frequency band filter allowing only a particular frequency band to control the toy or the device. Alternatively, the toys and devices have a microprocessor that analyzes the incoming sound and compares it with an expected sound spectrum of the toy or device. For example, a mobile will respond to the rattle bracelet on the infant's wrist but not to ambient sounds nor to the sounds of the infant crying.

An aspect of some preferred embodiments of the present invention is to provide toys and devices that respond differently to different rates of sound production, such as different rates of rattling (wherein the sound may or may not be incidental).

In preferred embodiments of this aspect, the responding toy or device has a appropriate circuitry that analyzes the rate of sound production and responds in kind. For example, a mobile may play a fast tune in response to a fast rate of rattle and a slow tune in response to a slow rate of rattle, a "chase-me" ball will roll away faster as a toddler wearing a rattle bracelet chases it faster.

An aspect of some preferred embodiments of the present invention is to provide a plurality of toys and devices all controlled by a single sound maker (wherein the sound may or may not be incidental).

In preferred embodiments of this aspect, a small child or an invalid may control several devices such as lights, an air conditioner or a music system with one sound maker.

An aspect of some preferred embodiments of the present invention is to provide a plurality of toys and devices and a plurality of sound makers, each having a unique sound, wherein there is a one-to-one correspondence between the toys and devices on the one hand and the sound makers on the other, so that each toy or device responds only to the specific sound of its corresponding sound maker (wherein the sound may or may not be incidental).

In preferred embodiments of this aspect, a small child may entertain himself with a plurality of sound makers, and a plurality of corresponding toys and devices will respond to the sounds in a respective manner. For example, an arrangement may comprise a plurality of ~~squeaking, toy, baby animals, and a plurality of corresponding, toy, mother animals, each with~~ a microphone and a filter band so as to respond only to the squeaking sounds of its own toy baby. As a child squeaks any of the toy baby animals, a toy mother animal calls out for her baby. Alternatively, the toy mother animal may also have a motor and turns to face its toy baby, or advance towards it.

An aspect of some preferred embodiments of the present invention to provide a plurality of sound makers, each having a unique sound, to control different functions of a single toy or device (wherein the sound may or may not be incidental).

In preferred embodiments of this aspect, a small child may entertain himself with a plurality of sound makers, and a multi-functional toy will respond. For example, an arrangement may comprise a toy computer and a plurality of sound makers that operate as function keys. In a preferred embodiment of the invention, the multi-function toy comprises a computer game (e.g., space invaders), wherein controllable elements of the game are controlled responsive to the direction, amplitude, distance and/or changes therein. In one example, the motion of a spaceship is dependent on the direction and/or speed of motion of the sound source. the parameters of the sound source may be determined using a one or more microphones, as described above. In a preferred embodiment of the invention, an arrangement may comprise a toy computer and a plurality of squeaking toy animals. As a child squeaks any of the toy animals, the toy computer pronounces the name of the animal

An advantage to controlling toys and devices by sounds is that there is no need to resort to electromagnetic radiation for remote control especially where small children are involved.

In a preferred embodiment of the invention, the toy utilizes a microcontroller to analyze received sounds. Thus, several different sounds can be responded to at a same manufacturing as responding to a single sound.

There is thus provided in accordance with a preferred embodiment of the invention, a method of controlling at least one device by incidental sound produced by a living creature and including:

attaching a sound-maker to a living creature so that the natural movements of the living creature will cause the sound-maker to emit a sound;

receiving the sound by at least one device; and

responding by some physical response to the sound, by the at least one device.

Preferably, receiving comprises stereophonically receiving and including:

analyzing the direction of the incoming sound,

wherein responding includes responding to a specific direction in relation to the direction of the received sound.

Alternatively or additionally, receiving comprises differentially receiving sounds coming from different directions and including:

analyzing the direction of the incoming sound,

wherein responding includes responding to a specific direction in relation to the direction of the received sound.

There is also provided in accordance with a preferred embodiment of the invention, a method of controlling at least one device by sound and including:

generating a sound by a non-human sound-maker;

stereophonically receiving the sound by at least one device;

analyzing the direction of the received sound; and

responding, by the at least one device to a specific direction in relation to the direction of the received sound.

There is also provided in accordance with a preferred embodiment of the invention, a method of controlling at least one device by sound and including:

generating a sound by a non-human sound-maker;

differentially receiving sounds coming from different directions;

analyzing the direction of the received sound; and

responding, by the at least one device to a specific direction in relation to the direction of the received sound.

In a preferred embodiment of the invention, a living creature causes the sound to be

generated.

In a preferred embodiment of the invention, the method includes analyzing whether the source of the sound is approaching or moving away, wherein responding includes responding differently to a sound source that is approaching and to a sound source that is moving away.

There is also provided in accordance with a preferred embodiment of the invention, a method of controlling at least one device by sound and including:

generating a sound by a sound-maker;

receiving the sound by at least one device;

analyzing whether the source of the sound is approaching or moving away; and

responding differently by the at least one device to a sound source that is approaching and to a sound source that is moving away.

Preferably, wherein a living creature causes the sound to be generated.

In a preferred embodiment of the invention, the method includes analyzing the distance from at least one device to the sound-maker, wherein responding includes responding differently to sound sources from different distances.

There is also provided in accordance with a preferred embodiment of the invention, a method of controlling at least one device by sound and including:

generating a sound by a sound-maker;

receiving the sound by at least one device;

analyzing the distance from at least one device to the sound-maker; and

responding differently by the at least one device to sound sources from different distances.

Preferably, a living creature causes the sound to be generated.

In a preferred embodiment of the invention, the method includes analyzing the sound for amplitude, wherein responding includes responding differently to different amplitudes.

There is also provided in accordance with a preferred embodiment of the invention, a method of controlling at least one device by sound and including:

generating a sound by a sound-maker;

receiving the sound by at least one device;

analyzing the sound for amplitude; and

responding differently by the at least one device to different amplitudes.

Preferably, a living creature causes the sound to be generated.

In a preferred embodiment of the invention, the sound is characteristic of the sound maker and wherein the device responds only to the characteristic sound. Alternatively or

additionally, the method includes analyzing the sound for pitch; wherein responding includes responding differently to different pitches.

There is also provided in accordance with a preferred embodiment of the invention, a method of controlling at least one device by sound and including:

generating a characteristic sound by a sound-maker;

receiving the characteristic sound by at least one device;

analyzing the characteristic sound for pitch; and

responding differently by the at least one device to different pitches.

Preferably, a living creature causes the sound to be generated.

In a preferred embodiment of the invention, the method includes analyzing the sound for sound-production rate; wherein responding includes responding differently to different rates.

There is also provided in accordance with a preferred embodiment of the invention, a method of controlling at least one device by sound and including:

generating a sound by a sound-maker;

receiving the sound by at least one device;

analyzing the sound for sound-production rate; and

responding differently by the at least one device to different rates.

Preferably, a living creature causes the sound to be generated.

In a preferred embodiment of the invention, at least one device comprises at least one toy. Alternatively or additionally, at least one device comprises at least one electrical appliance. Alternatively or additionally, at least one device comprises at least one lighting device. Alternatively or additionally, at least one device comprises a plurality of devices.

In a preferred embodiment of the invention, the method comprises providing a plurality of devices and a plurality of sound makers, wherein there is a one to one correspondence between the sounds produced by the sound makers and the devices and including:

generating a sound of specific characteristics by one of the plurality of sound makers;

receiving the sound by the plurality of devices;

analyzing the sound characteristics by the plurality of devices; and

responding only by the corresponding device to the specific sound characteristics of its sound maker.

There is also provided in accordance with a preferred embodiment of the invention, a method of controlling a plurality of devices by a plurality of sound makers, wherein there is a one to one correspondence between the sound makers and the devices and including:

generating a sound of specific characteristics by one of the plurality of sound makers;

receiving the sound by the plurality of devices;

analyzing the sound characteristics by the plurality of devices; and

responding only by the corresponding device to the specific sound characteristics of its corresponding sound maker.

Preferably, a living creature causes the sound to be generated.

In a preferred embodiment of the invention, the living creature is a child, preferably a child lacking fine motor control. Alternatively or additionally, the living creature is an infant lacking fine motor control. Alternatively or additionally, the living creature is an invalid. Alternatively or additionally, the living creature is an animal.

~~In a preferred embodiment of the invention, the method comprises:~~

providing a plurality of sound-makers, each generating a characteristic sound when activated and a single multifunctional device;

generating a sound of specific characteristics by one of the plurality of sound makers;

receiving the sound by the device;

analyzing the sound characteristics by the device; and

responding by the device with a specific function to the specific sound characteristics of the sound maker.

In a preferred embodiment of the invention, responding comprises producing an audio output. Alternatively or additionally, responding comprises producing a light display. Alternatively or additionally, responding comprises producing a response on a computer screen. Alternatively or additionally, receiving comprises sensing the direction of the sound source and comprising:

controlling at least one element in a computer game responsive to said received sounds.

In a preferred embodiment of the invention, controlling comprises moving the element responsive to the sensed direction. Alternatively or additionally, responding comprises generating motion on the device. Preferably, generating motion comprises turning a head. Alternatively or additionally, moving comprises moving eyes. Alternatively or additionally, moving comprises moving a nose. Alternatively or additionally, moving comprises moving ears. Alternatively or additionally, moving comprises moving a mouth.

In a preferred embodiment of the invention, responding comprises moving the device. Preferably, moving comprises moving on limbs. Alternatively or additionally, moving comprises moving on wheels. Alternatively or additionally, moving comprises moving on treads. Alternatively or additionally, moving comprises moving at a predetermined angular

orientation. Alternatively or additionally, moving comprises moving at a variable angle.

In a preferred embodiment of the invention, the sound comprises ultrasound. Alternatively or additionally, the sound comprises infra-sound.

There is also provided in accordance with a preferred embodiment of the invention, apparatus comprising:

a sound-maker which produces a sound when moved;

means of attaching the sound-maker to a living creature so that the natural movements of the living creature will cause the sound-maker to emit said sound; and

at least one device that receives the sound and produces a physical response, responsive only to the sound.

Preferably, the sound maker produces a characteristic sound and wherein the device responds only to the characteristic sound. Alternatively or additionally, the at least one device comprises:

a sound receiver that receives the sound and produces at least one sound signal responsive thereto;

a sound analyzer, that receives the at least one sound signal and determines if a physical response should be made; and

a responsive element that performs the physical response, responsive to the determination.

Preferably, the sound receiver is a stereophonic receiver;

the sound analyzer determines the direction of the sound from the at least one signal; and

the responsive element responds relative to a specific direction with respect to the determined direction of the sound source.

Alternatively or additionally, the sound receiver is a receiver having an angular dependence;

the sound analyzer determines the direction of the sound from the at least one signal; and

the responsive element responds relative to a specific direction with respect to the determined direction of the sound source.

There is also provided in accordance with a preferred embodiment of the invention, apparatus comprising:

a sound-maker which produces a sound when moved;

at least one device comprising:

a stereophonic sound receiver that receives the sound and produces at least one sound signal responsive thereto;

a sound analyzer, that receives the at least one sound signal and determines the direction of the sound and whether a response should be made to the sound; and

a responsive element that performs a physical response, responsive to the determination.

There is also provided in accordance with a preferred embodiment of the invention, apparatus comprising:

a sound-maker which produces a sound when moved;

at least one device comprising:

a sound receiver comprising a microphone having an angular dependence that receives the sound and produces at least one sound signal responsive thereto;

a sound analyzer, that receives the at least one sound signal and determines the direction of the sound and whether a response should be made to the sound; and

a responsive element that performs a physical response, responsive to the determination.

In a preferred embodiment of the invention, the responsive element causes a response related to the determined direction.

In a preferred embodiment of the invention, the sound analyzer determines whether the sound maker is approaching or receding from the device; and

the responsive element performs a physical response dependent on the determination.

There is also provided in accordance with a preferred embodiment of the invention, apparatus comprising:

a sound-maker which produces a sound when moved;

at least one device comprising:

a sound receiver that receives the sound and produces at least one sound signal responsive thereto;

a sound analyzer, that receives the at least one sound signal and determines whether the sound maker is approaching or receding from the device and whether a response should be made to the sound; and

a responsive element that performs a physical response, responsive to the determination.

Preferably, the response is different depending on whether the source is determined to be approaching or receding.

In a preferred embodiment of the invention, the sound analyzer determines whether a sound source is approaching or receding by the Doppler effect on the sound frequency. Alternatively or additionally, the sound analyzer determines whether a sound source is approaching or moving away by a change in amplitude of the sound with time.

In a preferred embodiment of the invention, at least one device comprises a range finder which determines the distance to the sound source, where the response of the device is dependent on the determined distance.

There is also provided in accordance with a preferred embodiment of the invention, apparatus comprising:

a sound-maker which produces a sound when moved;

at least one device comprising:

a sound receiver that receives the sound and produces at least one sound signal responsive thereto;

a range finder that determines the distance to the sound maker;

a sound analyzer, that receives the at least one sound signal and determines whether a response should be made to the sound and receives the distance determination and determines a suitable response based on the distance; and

a responsive element that performs a physical response, responsive to the determinations made by the sound analyzer.

In a preferred embodiment of the invention, the sound analyzer determines the amplitude of the sound and determines a physical response, responsive to the amplitude.

There is also provided in accordance with a preferred embodiment of the invention, apparatus comprising:

a sound-maker which produces a sound when moved;

at least one device comprising:

a sound receiver that receives the sound and produces at least one sound signal responsive thereto;

a sound analyzer, that receives the at least one sound signal and determines whether a response should be made to the sound and determines a suitable response based on an amplitude of the sound; and

a responsive element that performs a physical response, responsive to the determinations made by the sound analyzer.

In a preferred embodiment of the invention, the analyzer determines a rate of sound production and wherein the at least one device responds differently to different rates.

There is also provided in accordance with a preferred embodiment of the invention, apparatus comprising:

a sound-maker which produces a sound when moved;

at least one device comprising:

a sound receiver that receives the sound and produces at least one sound signal responsive thereto;

a sound analyzer, that receives the at least one sound signal and determines whether a response should be made to the sound and determines a rate of sound production; and

a responsive element that performs a physical response, responsive to the determinations made by the sound analyzer.

In a preferred embodiment of the invention, the sound maker produces a characteristic sound and wherein the analyzer makes its determination responsive to a characteristic of the received sound.

Preferably, the characteristic is pitch.

In a preferred embodiment of the invention, at least one device comprises at least one toy. Alternatively or additionally, at least one device comprises at least one electrical appliance. Alternatively or additionally, at least one device comprises at least one lighting device. Alternatively or additionally, at least one device comprises a plurality of devices. Alternatively or additionally, the apparatus comprises a plurality of devices and a plurality of sound makers, each having a characteristic sound, wherein there is a one to one correspondence between the sound makers and the devices and wherein each device responds only to a sound generated by its corresponding sound-maker.

In a preferred embodiment of the invention, the apparatus comprises a single multifunctional device and a plurality of sound-makers, each having a characteristic sound, wherein the single device responds with a specific function to each of specific sounds characteristics of the sound makers.

In a preferred embodiment of the invention, the apparatus comprises a single multifunctional device capable of determining a sound source parameter, wherein the single device responds with a specific function to different values of parameters.

Preferably, the parameter comprises a source direction.

In a preferred embodiment of the invention, the sound comprises ultrasound frequencies. Alternatively or additionally, the sound comprises infra-sound frequencies.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be more clearly understood with reference to the following detailed descriptions of non-limiting preferred embodiments of the invention in which:

Fig. 1 is a schematic representation of a preferred embodiment in accordance with some aspects of the present invention, illustrating an infant too young for motor control operating at least one toy by incidental sounds produced from a sound maker worn by him, such as a rattle anklet;

Fig. 2 is a schematic representation of a preferred embodiment in accordance with some aspects of the present invention, illustrating an infant too young for motor control operating a plurality of toys by incidental sounds produced from sound makers worn by him, such as a rattle anklet and a rattle bracelet;

Fig. 3 is a schematic representation of a preferred embodiment in accordance with some aspects of the present invention, illustrating a child playing with a sound-making toy, wherein a toy responding to the sound-making toy has a angle-dependent receiver that is sensitive to the direction of the sound and responds by turning its head to the direction of the sound and/or by walking towards the sound;

Fig. 4 is a schematic representation of a preferred embodiment in accordance with some aspects of the present invention, illustrating a child playing with a sound-making toy, wherein a toy responding to the sound-making toy has a angle-dependent receiver that is sensitive to the direction of the sound and wheels and responds by wheeling over towards the sound;

Fig. 5 is a schematic representation of a preferred embodiment in accordance with some aspects of the present invention, illustrating a child playing with a plurality of sound-making toys, wherein a plurality of corresponding responding toys, respond to sounds from their sound-making counterpart;

Fig. 6 is a schematic representation of a preferred embodiment in accordance with some aspects of the present invention, illustrating a child playing with a toy computer, using a plurality of sound-making toys as his function keys;

Fig. 7 is a schematic representation of a preferred embodiment in accordance with some aspects of the present invention, illustrating a child playing with a toy computer wherein as he plays with a particular sound-making toy, the toy computer pronounces its name;

Fig. 8 is a schematic representation of a preferred embodiment in accordance with some aspects of the present invention, illustrating a child crawling through the house with a sound-maker, such as a rattle, attached to his person, wherein a plurality of responding toys respond to his coming and going in a variety of ways;

Fig. 9 is a schematic representation of a preferred embodiment in accordance with some aspects of the present invention, illustrating a child who wakes up late at night and relies on a sound maker on his person to turn on the lights and some soothing music for him;

Fig. 10 is a schematic representation of a preferred embodiment in accordance with some aspects of the present invention, illustrating an invalid wearing a sound maker so that, as he enters a room, various electrical devices are turned on for his convenience;

Fig. 11 is a schematic representation of a preferred embodiment in accordance with some aspects of the present invention, illustrating a pet wearing a sound maker and thereby controlling a pet door that has an electric lock; and

Fig. 12 is a schematic representation of some preferred embodiment in accordance with some aspects of the present invention, illustrating in a block diagram the manner of operation of the toys and devices described here.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 illustrates an infant 10, preferably one too young for fine motor control, who operates at least one toy about his crib 12, utilizing apparatus in accordance a preferred embodiment of the invention. Infant 10 controls the at least one toy with incidental sounds produced by a sound maker such as a rattle anklet 14 worn on his ankle 16. An exemplary toy near crib 12 is a battery-operated mobile 18 comprising a microphone 20.

As infant 10 waggles his legs, the rattle sounds are picked up by microphone 20 of mobile 18, and mobile 18 begins to play. Preferably, mobile 18 plays for a specific duration each time the rattle sounds turn it on. Preferably, mobile 18 circuitry ignores sounds of rattle anklet 14 made while mobile 18 plays.

In a preferred embodiment of the invention, mobile 18 has a frequency-band filter tuned to the frequency of sound made by rattle anklet 14, such that mobile 18 responds only to sounds coming from rattle anklet 14.

In some preferred embodiments mobile 18 has several tunes in its memory and responds to different rates of rattling differently. For example, mobile 18 may play a fast tune in response to a fast rattling rate, and a slow tune in response to a slow rattling rate.

In some preferred embodiments mobile 18 has several tunes in its memory and responds to different rattling amplitudes differently. For example, mobile 18 may play a loud tune in response to a loud rattle and a soft tune in response to a soft rattle.

Fig. 2 illustrates infant 10 operating a plurality of battery-operated toys and devices at or near crib 12, in accordance with a preferred embodiment of the invention. Infant 10 controls the plurality of toys and devices with incidental sounds produced by sound-makers worn by

him or attached to [redacted] such as socks with sewn-on bells 22, w[redacted]on his feet 24, and a pressure sensitive bracelet 26, worn on his arm, close to his elbow 28. (As infant 10 bends his arm, bracelet 26 produces a sound.) Some toys are controlled by socks 22 and some by bracelet 26.

The plurality of battery-operated responding toys and devices in crib 12 may comprise, for example, a doll 30 that makes a giggling sound, a teddy bear 32 that hums a soft tune as if to itself, a "Jack-in-a-box" 34 that jumps up and/or sways to sounds produced from one of the sound-makers of infant 10, a bird 36 that chirps, a ballerina on a music box 38 that reels to the music of its music box, a moon-and-star-studded placard 40 that plays a tune, a music system 42 that plays a tune and/or a display of lights 44. In a preferred embodiment of the invention, ~~music system 42 includes a light show. In one embodiment, the light show~~ comprises one or more moving patterns, which are preferably projected on a ceiling or a wall using laser and/or collimated light patterns. Preferably, the patterns turn on, move, vibrate and/or change in response to the sounds of one of the sound maker of infant 10. Preferably, the light display is accompanied by music from music system 42.

Preferably, not all these toys are placed near or at crib 12 simultaneously. Rather, two or at most three toys are placed in crib 12 each time, and they are replaced from time to time.

Reference is now made to Fig. 3 which is a schematic representation of another preferred embodiment in accordance with some aspects of the present invention. Fig. 3 illustrates child 50 playing with at least one pair of a sound-making toy and a responding toy. For example, the sound-making toy may be a toy rattle bone 52, and the responding toy may be a battery-operated, motorized puppy 54. Preferably, rattle bone 52 is made as a hollow rigid toy of plastic in a shape of a bone preferably with marbles inside to make the rattling sound. In a preferred embodiment of the invention, toy puppy 54 includes a receiver 56 which differentiates between sounds arriving from different directions. In one embodiment, signals from two or more microphones may be combined to yield stereophonic detection. Alternatively or additionally, a microphone having an angular dependence reception may be used. In one example, the amplitude is dependent on the direction. Alternatively or additionally, the relative amplitudes of different frequencies is dependent on the direction. As used herein, direction may include horizontal directions and/or vertical directions. Preferably, head 58 of toy puppy 54 can turn independently. As child 50 rattles rattle bone 52, head 58 turns towards it. In some preferred embodiments, legs 60 of puppy 54 are also segmented at their joints and puppy 54 walks towards rattle bone 52. Preferably, the moving mechanism of toy puppy 54 is capable of moving forward and backward and turning a fixed degree to the left

or to the right. Where greater turns are required, toy puppy 54 may turn in several steps, as follows: turn, sense direction of incoming sound, turn further, sense direction of incoming sound, until the turn is complete. Alternatively, the moving mechanism of toy puppy 54 is capable of moving forward and backward and turning a variable degree to the left or to the right, so that a complete turn may be performed in one step. It should be pointed out that the invention is not limited to a toy puppy and any toy having a head and/or limbs such as a toy doll, a toy monkey, a toy ostrich, a to donkey or any other animal toy, as known in the art, may be used. Alternatively or additionally, other external appendages may respond, for example a rider mounted on a horse may wave. Alternatively or additionally, internal portions of the toy may respond, for example, eye of the toy may open and close and/or turn in a direction of a sound source.

Fig. 4 illustrates child 50 playing with another pair of a sound-making toy and a wheeled responding toy. For example, the sound-making toy may be a toy car horn 62 and the responding toy may be a battery-operated, motorized car 64. Preferably, toy car horn 62 is a rubber button that squeaks when pressed. Alternatively toy car horn 62 may be an old-fashioned bicycle blow horn. Preferably, toy car 64 include a direction detection circuitry 66, for example as described with reference to Fig. 3. Preferably, when child 50 presses horn 62, car 64 wheels over towards him or away from him. Preferably, the moving mechanism of toy car 64 is capable of moving forward and backward and turning a fixed degree (such as 10^0) to the left or to the right. Where greater turns are required, toy car 64 will preferably turn in several steps. Alternatively or additionally, the moving mechanism of toy car 64 is capable of moving forward and backward and turning a variable degree to the left or to the right, so that the complete turn is performed in one step. It should be pointed out that the invention is not limited to a toy car, and any other toys on wheels, such as a truck, a train, a tractor, a motorcycle, a tractor and others as known in the art, as well as treaded toys such as a treaded tractor or a treaded robot and other treaded toys, as known in the art, may be advantageously used.

Alternatively or additionally, other motion mechanisms, besides wheels and legs may be controlled in response to the sounds, for example, crawling, swimming and rolling. In one example, a rolling ball may comprise an inner ball mounted on gimbals in an outer ball. The inner ball is preferably weighted so that it maintains a fixed orientation relative to the Earth. When the ball is to move in a certain direction, a motor, preferably in the inner ball rotates the inner ball against the outer ball in a desired direction, so that the ball advances in the desired direction.

Reference is made to Fig. 5 which is a schematic representation of another preferred embodiment in accordance with some aspects of the present invention. Fig. 5 illustrates child 50 and a plurality of pairs of sound-making toys and corresponding responding toys about him. Each sound-making toy has a distinct pitch or sound pattern, and each responding toy has a hidden microphone and a sound analyzer so as to respond to the specific pitch or sound pattern of its corresponding sound-making toy. For example, the plurality of sound-making toys may comprise baby animals that squeak, each with a distinct sound. Preferably, these include a toy lamb 72, a toy colt 74, a toy goat kid 76 and a toy calf 78. The plurality of responding toys may comprise battery-operated mother animals, each having an audio output. Preferably, these include a toy sheep 82, a toy horse 84, a toy goat 86 and a toy cow 88. As child 50 plays and produces sounds with toy lamb 72, toy sheep 82 calls out to her baby. Similarly, as child 50 plays and produces sounds with another toy baby, its mother calls out for it.

In some preferred embodiments, the toy mothers comprise a direction detection circuitry, for example as described with reference to Fig. 3. Alternatively or additionally, the toys include articulating limbs and/or heads, for direction responsive responses, for example as described with reference to Fig. 3. For example, as toy colt 74 produces sounds, toy horse 84 turns its head 85 towards her colt, as well as calls out. Alternatively, toy horse 84 may advance towards its baby.

With regard to the preferred embodiments of Fig.'s 3, 4, and 5, the invention is not limited to the specific pairs of toys described. Other pairs of sound-making toys and responding toys may be advantageously used. For example, a sound-making human baby doll, and a battery-operated mother doll with an audio output, a sound-making love bird and a responding battery-operated mate which sings, a sound producing baby bottle that squeaks, and a baby doll that crawls towards it, preferably with an audio output. Many other combinations will occur to persons skilled in the art.

Reference is now made to Fig. 6 which illustrates an alternative embodiment of the invention. Fig. 6 illustrates child 50 playing with a toy computer 90 and with several sound-making toys about him, each capable of generating a distinct sound, wherein the sound-making toys operate activate functions of toy computer 90. For example, the sound-making toys may be different-type rattles. In a preferred embodiment of the invention, when child 50 plays with rattle 92, toy computer 90 responds, for example by flashing in many colors. Preferably, the rate of flashing and the intensity vary with the rate of rattling and its intensity. Alternatively or additionally, toy computer 90 plays a musical tune. Preferably, the toy computer has several

tunes stored in its memory, and plays a different tune and/or modulates the tune (e.g. fast, slow, loud or soft), depending on the rattle sound. Alternatively or additionally, the tune is elected to match audio characteristics of the sound and/or of an object represented by the rattle (i.e. a cow shaped rattle). Alternatively or additionally, toy computer 90 displays a short cartoon script responsive to the sound, for example different scripts for different rattles.

In a preferred embodiment of the invention, toy computer 90 comprises a play station (or a suitably programmed computer) executing an interactive game. Preferably, the computer detects parameters of the sounds and the interaction is made responsive to the sound. In one example, a spaceship on the computer screen may move to the same direction as that which the sound is coming from (e.g. up, down left or right). In another example, the control may be responsive to the sound amplitude and/or rate of change of location. Alternatively or additionally, certain activities, for example firing a missile (corresponding to pressing a fire button) may also be performed in response to particular sounds. In another example, the direction of motion is dependent on the type of sounds, with four sound makers preferably being provided to allow four control directions.

In one embodiment of the invention, sound-making toys 92, 94, 96 and 98 may be battery-operated beepers, each having a distinct pitch and/or beeping pattern. In some preferred embodiments, the amplitude of the beeps is made responsive to a pressure applied to a beep button (which works like an organ key). Toy computer 90 may respond to the different pitches, patterns, and sometimes also amplitudes of the beeps with different functions.

The invention is not limited to the particular computer functions described. Other toy computer functions, as known in the art, may be advantageously employed.

Reference is now made to Fig. 7 which is a schematic representation of another preferred embodiment in accordance with some aspects of the present invention. Fig. 7 illustrates child 50, playing with a toy computer 100 and with several sound-making toys about him, each having a distinct sound. For example, the sound-making toys may be toy fruits that squeak. As child 50 picks up a toy banana 102 and squeaks it, toy computer 100 pronounces the word "banana". As child 50 picks up a toy apple 104 and squeaks it, toy computer 100 pronounces the word "apple". As child 50 picks up a toy orange 106 and squeaks it, toy computer 100 pronounces the word "orange".

Alternatively or additionally to vocalizing, toy computer 100 may display a picture representative of the squeaked toy.

Alternatively, toy computer 100 displays a picture of a person pronouncing the names of the toys.

Alternatively, [illegible]art doll may be used in place of toy comp[illegible]100 to pronounce the names of the toys.

Alternatively, a "wise" toy animal such as a toy parrot may be used to pronounce the names of the toys.

Alternatively, toy computer 100 may be embedded in a different type of stuffed animal and/or other types of toys, for example vehicles.

Alternatively or additionally, several responding toys, for example, a teddy bear, a toy parrot and a doll may be used, to pronounce the name of the toys. Possibly, each toy may respond only to some of the squeakers, for example, a seal will respond to a fish but not to a banana.

The invention is not limited to the pronouncement of the names of the three toy of Fig. 7, nor is it limited to pronouncing fruit names. Other sound-making toys, as known in the art, may be advantageously named. Alternatively or additionally, other words may be vocalized in response to toys, for example the phrase "please kiss the baby" may be vocalized by a "mother" doll in response to a "baby" doll being squeezed.

In some preferred embodiments the sound-making toys may trigger responses from several responding toys. For example, the sound-making baby animal toys described in the preferred embodiment of Fig. 6 to trigger responses from mother animals, may also be used in preferred embodiments described in Fig. 7 to trigger responses from toy computer 100, or from some other name pronouncing toy.

Reference is now made to Fig. 8 which is a schematic representation of another preferred embodiment in accordance with some aspects of the present invention. Fig. 8 illustrates child 50 crawling about the house. Attached to his person is a sound maker such as a rattle bracelet 108. As child 50 crawls about the house, a plurality of responding, battery-operated toys and devices respond to his coming and going. For example, doll 110, which has appropriate circuitry for discerning if a sound source is approaching or moving away, says, "Hello," as child 50 approaches, and "See you later," as he crawls away. An "I-am-always-behind-you" toy puppy 112, having a receiver that is sensitive to the direction of the sound, a motor, a head and limbs that are preferably segmented at their joints and appropriate circuitry to analyze the direction and speed of child 50, follows child 50 wherever he goes. A toy duckling 114, similarly structured, but with an audio output, comes forward to greet child 50 with a quack. A toy bird 116 chirps as child 50 passes by. A toy cat 118 purrs as child 50 approaches, and meows as child 50 moves away. "A chase-me" ball 120 rolls away from child 50. As child 50 speeds up and tries to catch it, the ball preferably rolls away faster. Sometimes

they form a procession, with ball 120 leading the way, child 50 chasing it, puppy 112 following child 50 and last in the procession, duckling 114 waddling and quacking. It should be pointed out that the "chase-me" toy need not be a ball, and any other moving toy such as a toy ostrich, a toy rabbit, a toy car, a toy tractor, and any other moving toy, as known in the art, may be advantageously used.

Fig. 9 illustrates an alternative group of applications in which sounds are used to control household devices, in accordance with a preferred embodiment of the invention. Fig. 9 illustrates a child 200 who goes to sleep with a sound maker such as a soft rattle bracelet 202 by his bed 204. One or more devices in the house, for example, one or more lights 206 or a music system 208 include microphones and appropriate circuitry to determine if a sound source is approaching or going away and how far it is, and respond accordingly. If child 200 wakes up in the night, he needs only put on his soft rattle bracelet 202. In a preferred embodiment of the invention, soft rattle 202 may turn on lights 206 and/or music system 208, preferably in the room. Alternatively or additionally, lights outside the room may be turned on, for example, if child 200 walks to the bathroom, the lights in the corridor and in the bathroom will turn on. If he wants a drink of water, and walks to the kitchen, the kitchen light will turn on. As child 200 returns to the room, the house lights will turn off.

Fig. 10 illustrates an invalid person 210 wearing a sound-making bracelet 212 on his wrist. In a preferred embodiment of the invention, one or more devices in the house include microphones and sound analyzers to detect and analyze sounds from sound maker 212 and respond accordingly. Preferably, the sound analyzers discern if sound maker 212 is approaching or going away and/or a distance to sound maker 212. For example, lights 214, an air conditioner 216 and a TV 218 are turned on as invalid person 210 enters a room, and lights 214, air conditioner 216 and TV 218 are turned off as invalid person 210 leaves the room.

In some preferred embodiment, a plurality of sound-makers is available for different times of the day and for different seasons. For example, on a winter night, invalid person 210 will have on him a sound-maker that will turn on lights, a heater, and a television. But during a summer day, invalid person 210 will have on him a sound-maker that will turn on an air-conditioner or a fan and a music system, or a computer. Alternatively or additionally, the sound responsive devices may be programmed to respond differently depending on time of day and/or date.

Fig. 11 illustrates a pet 220 wearing a sound-making collar 222. Pet 220 can let itself in and out of a pet spring door 224 that is locked with an electric lock 226. Preferably, pet door 224 has a microphone 228 and a sound analyzer to senses the approach of the pet and opens

lock 226, responsive to the sound. Preferably, as pet 220 approaches door 224, electric lock 226 opens. As pet 220 moves away from the door, lock 226 shuts.

Reference is now made to Fig. 12 which is a schematic representation of the manner of operation of preferred embodiments of the invention, by a block diagram 230. Block diagram 230 comprises four basic components: a receiving component 232, a sound analyzer 234, a controller 236, and a responsive element 238.

Receiving component 232 may comprise a single receiver, a stereo (or quadrate) receiver, or a receiver comprising a single microphone that has an angular dependence. Such a receiver may be able to determine one or two angular axes of orientation. Alternatively or additionally, sound analyzer 234 may be able to determine one, two or three-dimensional position in space. Preferably, the determinations are of cylindrical coordinates (i.e., pitch, yaw and distance)..

Sound analyzer 234 and controller 236 may be embodied in a single unit, for example in a microprocessor. In a preferred embodiment of the invention, the sound frequencies are selected to be in relatively noise free frequency bands. Alternatively or additionally, the frequency is above 10kHz. Alternatively or additionally, the frequency is above 12kHz. Sound analyzer 234 preferably includes a band-pass filter for these frequencies. Preferably, the filter is at an entrance to sound analyzer 234, so that most of sound analyzer 234 does not draw power when an "out of band" sound is received by receiver 232. Preferably, sound analyzer 234 includes a noise filter for rejecting sounds at levels similar to and/or below ambient sound levels. Preferably sound analyzer 234 self-calibrates by determining ambient sound levels when it is first turned on and/or if it is not used for a significant period of time.

Responsive element 238 may include a motor for providing a physical response by motion, a speaker for providing a physical response by audio output, a lighting device for providing a physical response by light and an on/off switch. In a preferred embodiment of the invention, controller 236 modulates a supply of power to responsive element 238, to effect the desired response. For example, controller 236 may switch on power to a motor which rotates wheels on a wheeled toy.

As described herein above, sound analyzer may discriminate several different sounds and parameters of these sounds, including different sound sources, sound directions, sound amplitudes, sound pitches, sound motion, preferably by Doppler analysis, distance, preferably utilizing a constant amplitude sound source or by comparing the relative amplitudes of different frequency bands, each of which is differentially attenuated by the atmosphere, motion rate and/or absolute location. In a preferred embodiment of the invention, controller 236

includes a logic element which maintains an internal state and controls responsive element 238 differentially responsive to the state. Thus, different responses and/or magnitude of responses may be affected for a same sound source, depending on the internal state.

In one example, controller 236 includes a state machine. In an example of a "run-away car", a first rattle will make the car move away, a second rattle will make it move faster and a third (and possibly subsequent) rattle will make the car go in circles surrounding the noise source. Alternatively or additionally, the logic may include a functional dependency, for example, the speed of the car may be a function of the sound amplitude. Alternatively or additionally, the logic may include measurements of time, for example the car will start slowing down after 30 seconds and/or will stop and/or flash lights if no sound is detected for 1 minute. Alternatively or additionally, the logic may respond to parameters of the toy, for example battery level and length of time activated. Alternatively or additionally, combinations of the above logics may be provided. In a preferred embodiment of the invention, the toy may include one or more switches, such as dip switches, to select different logics. Alternatively or additionally, the toy may include a memory, for example, the toy determines a distance to a sound maker and then advances that distance, even if the sound maker ceases from creating sounds.

It should be noted that the sound makers of the preferred embodiments of the invention are not limited to rattles, bells, squeaky toys, pressure-sensitive instruments, or battery operated beepers. Other sound makers, such as whistles, thimbles, triangles, small drums and others as known in the art, may be advantageously employed.

In some preferred embodiments the sound maker may be a rattle anklet as described. Alternatively, it may be a rattle bracelet. The anklet or bracelet may have a stretchable band. Alternatively, they may clasp the wrist or ankle, possibly as a soft (cloth coated) spring clip. Alternatively, they fit with a band like that of a wrist watch. In some preferred embodiments, the sound maker may be a pendant. In some preferred embodiments, the sound maker may be sewn onto an article of clothing such as to the infant's socks, to the infant's sleeve or to the infant's pants. In some preferred embodiment the sound maker may be attached to an article of clothing by a safety pin, held by a clip such as a tie clip, hung on a button, or worn as a pin. Alternatively or additionally, the sound maker may include a plurality of hard objects inside a cavity. Alternatively or additionally, the sound maker may include crinkle material. Alternatively or additionally, the sound maker may include tines which generate a substantially single frequency sound.

Preferably, the sounds of the sound makers are pleasant or at least not irksome to people and/or to pets. In some preferred embodiments the sounds of the sound makers are inaudible to humans. In some preferred embodiments the sounds of the sound makers are inaudible to humans as well as to pets. In a preferred embodiment of the invention, inaudible sounds comprise infra sounds, at frequencies below human and/or pet hearing ability. Alternatively or additionally, inaudible sounds comprise ultrasonic sound, above human hearing abilities and/or above pet hearing abilities. Preferably, the terms infra-sound and ultra-sound reflect the hearing abilities of a 20 year old healthy human male. Alternatively, the frequencies may be selected to be outside of a child's hearing range. Alternatively or additionally, the sound frequencies may be selected to suit an older person. In a preferred embodiment of the invention, the sound wave is carried in the atmosphere. Alternatively or additionally, the sound is carried in a liquid, for example in bath toys. Alternatively or additionally, the sound may be carried by solids, for example through a floor.

It should be noted that the invention is not limited to the toys described here. Other toys capable of responding to an electrical signal may be advantageously employed, by modulating the electrical signals responsive to the sounds.

The toys may be activity centers, dolls, toy animals, stuffed animals, toy cars, toy trucks, toy airplanes, toy helicopters, toy trains, toy boats, toy puppets, toy appliances, toy computers, toy music systems, toy cameras, toy TV, toy radios, toy tape players.

The response of the toys may be by sounds, such as in pronouncing a word, a combination of words, crying, laughing, giggling, singing, playing a melody, ringing, whistling, various engine and motor sounds such as of cars, trains, helicopters, airplanes , horn sounds, animal sounds such as the singing of birds, hooting, barking, meowing, purring, mooing, other animal sounds and other sounds in general.

Alternatively or additionally, the response of the toys may be by flashing lights of one or several colors, or by blinking of lights wherein the light source may comprise light bulbs of different kinds, or laser light of one or several colors.

Alternatively, or additionally, the response may be a musical piece.

Alternatively or additionally, the response of the toys may be by movement, such as by a stuffed animal raising its arms, a toy puppy wagging its tail, a Jack in the Box jumping out and swaying, a car running, a robot moving and turning, a toy doll or a toy animal turning its head, moving its arms or walking, a ball rolling.

In some preferred embodiments the sound maker and the responding toy are bought together, for example, a mobile and an rattle anklet that operates it, or a singing moon-and

star-studded placard and a rattle bracelet that operates it. In other preferred embodiments the responding toys have a frequency-band filter and a tuning button so that they can be tuned to operate with existing or home made sound makers.

It should be noted that the invention is not limited to the specific electrical appliances and lighting described here turning on and off. Other electrical appliances and electrical systems may be advantageously activated.

The invention described herein is not limited to the particular preferred embodiment described herein, nor for those embodiments, to particular elements described. The limits of the protected invention are defined by the following claims. In the claims, the terms "comprising", "comprises", "including" "includes", or the like means "including but not necessarily limited to."

CLAIMS

1. A method of controlling at least one device by incidental sound produced by a living creature and including:

attaching a sound-maker to a living creature so that the natural movements of the living creature will cause the sound-maker to emit a sound;

receiving the sound by at least one device; and

responding by some physical response to the sound, by the at least one device.

2. A method according to claim 1, wherein receiving comprises stereophonically receiving and including:

analyzing the direction of the incoming sound,

wherein responding includes responding to a specific direction in relation to the direction of the received sound.

3. A method according to claim 1, wherein receiving comprises differentially receiving sounds coming from different directions and including:

analyzing the direction of the incoming sound,

wherein responding includes responding to a specific direction in relation to the direction of the received sound.

4. A method of controlling at least one device by sound and including:

generating a sound by a non-human sound-maker;

stereophonically receiving the sound by at least one device;

analyzing the direction of the received sound; and

responding, by the at least one device to a specific direction in relation to the direction of the received sound.

5. A method of controlling at least one device by sound and including:

generating a sound by a non-human sound-maker;

differentially receiving sounds coming from different directions;

analyzing the direction of the received sound; and

responding, by the at least one device to a specific direction in relation to the direction

of the received sound.

6. A method according to claim 4 or to claim 5 wherein a living creature causes the sound to be generated.

7. A method according to any of claims 1-6, including analyzing whether the source of the sound is approaching or moving away, wherein responding includes responding differently to a sound source that is approaching and to a sound source that is moving away.

8. A method of controlling at least one device by sound and including:

generating a sound by a sound-maker;

receiving the sound by at least one device;

analyzing whether the source of the sound is approaching or moving away; and

responding differently by the at least one device to a sound source that is approaching and to a sound source that is moving away.

9. A method according to claim 8 wherein a living creature causes the sound to be generated.

10. A method according to any of claims 1-9, including analyzing the distance from at least one device to the sound-maker, wherein responding includes responding differently to sound sources from different distances.

11. A method of controlling at least one device by sound and including:

generating a sound by a sound-maker;

receiving the sound by at least one device;

analyzing the distance from at least one device to the sound-maker; and

responding differently by the at least one device to sound sources from different distances.

12. A method according to claim 11 wherein a living creature causes the sound to be generated.

13. A method according to any of claims 1-12, including analyzing the sound for

amplitude, wherein responding includes responding differently to different amplitudes.

14. A method of controlling at least one device by sound and including:
generating a sound by a sound-maker;
receiving the sound by at least one device;
analyzing the sound for amplitude; and
responding differently by the at least one device to different amplitudes.

15. A method according to claim 14 wherein a living creature causes the sound to be generated.

16. A method according to any of the preceding claims wherein the sound is characteristic of the sound maker and wherein the device responds only to the characteristic sound.

17. A method according to any of claims 1-16, including analyzing the sound for pitch; wherein responding includes responding differently to different pitches.

18. A method of controlling at least one device by sound and including:
generating a characteristic sound by a sound-maker;
receiving the characteristic sound by at least one device;
analyzing the characteristic sound for pitch; and
responding differently by the at least one device to different pitches.

19. A method according to claim 18 wherein a living creature causes the sound to be generated.

20. A method according to any of claims 1-18, including analyzing the sound for sound-production rate; wherein responding includes responding differently to different rates.

21. A method of controlling at least one device by sound and including:
generating a sound by a sound-maker;
receiving the sound by at least one device;
analyzing the sound for sound-production rate; and
responding differently by the at least one device to different rates.

22. A method according to claim 21 wherein a living creature causes the sound to be generated.

23. A method according to any of claims 1-22, wherein at least one device comprises at least one toy.

24. A method according to any of claims 1-23, wherein at least one device comprises at least one electrical appliance.

25. A method according to any of claims 1-24, wherein at least one device comprises at least one lighting device.

26. A method according to any of claims 1-25, wherein at least one device comprises a plurality of devices.

27. A method according to any of claims 1-26, comprising providing a plurality of devices and a plurality of sound makers, wherein there is a one to one correspondence between the sounds produced by the sound makers and the devices and including:

generating a sound of specific characteristics by one of the plurality of sound makers;

receiving the sound by the plurality of devices;

analyzing the sound characteristics by the plurality of devices; and

responding only by the corresponding device to the specific sound characteristics of its sound maker.

28. A method of controlling a plurality of devices by a plurality of sound makers, wherein there is a one to one correspondence between the sound makers and the devices and including:

generating a sound of specific characteristics by one of the plurality of sound makers;

receiving the sound by the plurality of devices;

analyzing the sound characteristics by the plurality of devices; and

responding only by the corresponding device to the specific sound characteristics of its corresponding sound maker.

29. A method according to claim 28 wherein a living creature causes the sound to be

generated.

30. A method according to any of claims 6, 9, 12, 15, 19, 22 or 29, wherein the living creature is a child.

31. A method according to any of claims 6, 9, 12, 15, 19, 22 or 29, wherein the living creature is an infant lacking fine motor control.

32. A method according to any of claims 6, 9, 12, 15, 19, 22 or 29, wherein the living creature is an invalid.

33. A method according to any of claims 6, 9, 12, 15, 19, 22 or 29, wherein the living creature is an animal.

34. A method according to any of claims 1-25, comprising:

providing a plurality of sound-makers, each generating a characteristic sound when activated and a single multifunctional device;

generating a sound of specific characteristics by one of the plurality of sound makers;

receiving the sound by the device;

analyzing the sound characteristics by the device; and

responding by the device with a specific function to the specific sound characteristics of the sound maker.

35. A method according to any of claims 1-34 wherein responding comprises producing an audio output.

36. A method according to any of claims 1-35 wherein responding comprises producing a light display.

37. A method according to any of claims 1-36 wherein responding comprises producing a response on a computer screen.

38. A method according to claim 37 wherein receiving comprises sensing the direction of the sound source and comprising:

controlling at least one element in a computer game responsive to said received sounds.

39. A method according to claim 38 wherein controlling comprises moving the element responsive to the sensed direction.

40. A method according to any of claims 1-39, wherein responding comprises generating motion on the device.

41. A method according to claim 40, wherein generating motion comprises turning a head.

42. A method according to any of claims 40-41 wherein moving comprises moving eyes.

43. A method according to any of claims 40-42 wherein moving comprises moving a nose.

44. A method according to any of claims 40-43 wherein moving comprises moving ears.

45. A method according to any of claims 40-44 wherein moving comprises moving a mouth.

46. A method according to any of claims 1-45, wherein responding comprises moving the device.

47. A method according to claim 46 wherein moving comprises moving on limbs.

48. A method according to any of claims 46-47 wherein moving comprises moving on wheels.

49. A method according to any of claims 46-48 wherein moving comprises moving on treads.

50. A method according to any of claims 46-49, ~~wherein moving comprises moving at a~~ predetermined angular orientation.

51. A method according to any of claims 46-50, wherein moving comprises moving at a

variable angle.

52. A method according to any of claims 1-51, wherein the sound comprises ultrasound.

53. A method according to any of claims 1-51, wherein the sound comprises infra-sound.

54. Apparatus comprising:

a sound-maker which produces a sound when moved;

means of attaching the sound-maker to a living creature so that the natural movements of the living creature will cause the sound-maker to emit said sound; and

at least one device that receives the sound and produces a physical response, responsive only to the sound.

55. Apparatus according to claim 54 wherein the sound maker produces a characteristic sound and wherein the device responds only to the characteristic sound.

56. An apparatus according to claim 54 wherein the at least one device comprises:

a sound receiver that receives the sound and produces at least one sound signal responsive thereto;

a sound analyzer, that receives the at least one sound signal and determines if a physical response should be made; and

a responsive element that performs the physical response, responsive to the determination.

57. Apparatus according to claim 56

wherein the sound receiver is a stereophonic receiver;

wherein the sound analyzer determines the direction of the sound from the at least one signal; and

wherein the responsive element responds relative to a specific direction with respect to the determined direction of the sound source.

58. Apparatus according to claim 56

wherein the sound receiver is a receiver having an angular dependence;

wherein the sound analyzer determines the direction of the sound from the at least one

signal; and

wherein the responsive element responds relative to a specific direction with respect to the determined direction of the sound source.

59. Apparatus comprising:

a sound-maker which produces a sound when moved;

at least one device comprising:

a stereophonic sound receiver that receives the sound and produces at least one sound signal responsive thereto;

a sound analyzer, that receives the at least one sound signal and determines the direction of the sound and whether a response should be made to the sound; and

a responsive element that performs a physical response, responsive to the determination.

60. Apparatus comprising:

a sound-maker which produces a sound when moved;

at least one device comprising:

a sound receiver comprising a microphone having an angular dependence that receives the sound and produces at least one sound signal responsive thereto;

a sound analyzer, that receives the at least one sound signal and determines the direction of the sound and whether a response should be made to the sound; and

a responsive element that performs a physical response, responsive to the determination.

61. Apparatus according to claim 59 or claim 60 wherein the responsive element causes a response related to the determined direction.

62. Apparatus according to any of claims 57-61,

wherein the sound analyzer determines whether the sound maker is approaching or receding from the device; and

wherein the responsive element performs a physical response dependent on the determination.

63. Apparatus comprising:

a sound-maker which produces a sound when moved;

at least one device comprising:

a sound receiver that receives the sound and produces at least one sound signal responsive thereto;

a sound analyzer, that receives the at least one sound signal and determines whether the sound maker is approaching or receding from the device and whether a response should be made to the sound; and

a responsive element that performs a physical response, responsive to the determination.

64. Apparatus according to claim 63 wherein the response is different depending on whether the source is determined to be approaching or receding.

65. Apparatus according to any of claims 62-64 wherein the sound analyzer determines whether a sound source is approaching or receding by the Doppler effect on the sound frequency.

66. Apparatus according to any of claims 62-65 wherein the sound analyzer determines whether a sound source is approaching or moving away by a change in amplitude of the sound with time.

67. Apparatus according to any of claims 56-66 wherein:

at least one device comprises a range finder which determines the distance to the sound source,

wherein the response of the device is dependent on the determined distance.

68. Apparatus comprising:

a sound-maker which produces a sound when moved;

at least one device comprising:

a sound receiver that receives the sound and produces at least one sound signal responsive thereto;

a range finder that determines the distance to the sound maker;

a sound analyzer, that receives the at least one sound signal and determines whether a response should be made to the sound and receives the distance determination and determines

a suitable response based on the distance; and

a responsive element that performs a physical response, responsive to the determinations made by the sound analyzer.

69. Apparatus according any of claim 56-67 wherein the sound analyzer determines the amplitude of the sound and determines a physical response, responsive to the amplitude.

70. Apparatus comprising:

a sound-maker which produces a sound when moved;

at least one device comprising:

a sound receiver that receives the sound and produces at least one sound signal responsive thereto;

a sound analyzer, that receives the at least one sound signal and determines whether a response should be made to the sound and determines a suitable response based on an amplitude of the sound; and

a responsive element that performs a physical response, responsive to the determinations made by the sound analyzer.

71. Apparatus according any of claim 54-70 wherein the analyzer determines a rate of sound production and wherein the at least one device responds differently to different rates.

72. Apparatus comprising:

a sound-maker which produces a sound when moved;

at least one device comprising:

a sound receiver that receives the sound and produces at least one sound signal responsive thereto;

a sound analyzer, that receives the at least one sound signal and determines whether a response should be made to the sound and determines a rate of sound production; and

a responsive element that performs a physical response, responsive to the determinations made by the sound analyzer.

73. Apparatus according to any of claims 56-70 wherein the sound maker produces a characteristic sound and wherein the analyzer makes its determination responsive to a characteristic of the received sound.

74. Apparatus according to claim 73 wherein the characteristic is pitch.

75. Apparatus according to any of claims 54-74, wherein at least one device comprises at least one toy.

76. Apparatus according to any of claims 54-75, wherein at least one device comprises at least one electrical appliance.

77. Apparatus according to any of claims 54-76, wherein at least one device comprises at least one lighting device.

78. Apparatus according to any of claims 54-77, wherein at least one device comprises a plurality of devices.

79. Apparatus according to any of claims 54-77 and comprising a plurality of devices and a plurality of sound makers, each having a characteristic sound, wherein there is a one to one correspondence between the sound makers and the devices and wherein each device responds only to a sound generated by its corresponding sound-maker.

80. Apparatus according to any of claims 54-77 and comprising a single multifunctional device and a plurality of sound-makers, each having a characteristic sound, wherein the single device responds with a specific function to each of specific sounds characteristics of the sound makers.

81. Apparatus according to any of claims 54-77 and comprising a single multifunctional device capable of determining a sound source parameter, wherein the single device responds with a specific function to different values of parameters.

82. Apparatus according to claim 81, wherein the parameter comprises a source direction.

83. Apparatus according to any of claims 54-82, wherein the sound comprises ultrasound frequencies.

84. Apparatus according to any of claims 54-82, wherein the sound comprises infra-sound frequencies.

ABSTRACT OF THE INVENTION

A method of controlling at least one device by incidental sound produced by a living creature and including:

attaching a sound-maker to a living creature so that the natural movements of the living creature will cause the sound-maker to emit a sound;

receiving the sound by at least one device; and

responding by some physical response to the sound, by the at least one device.

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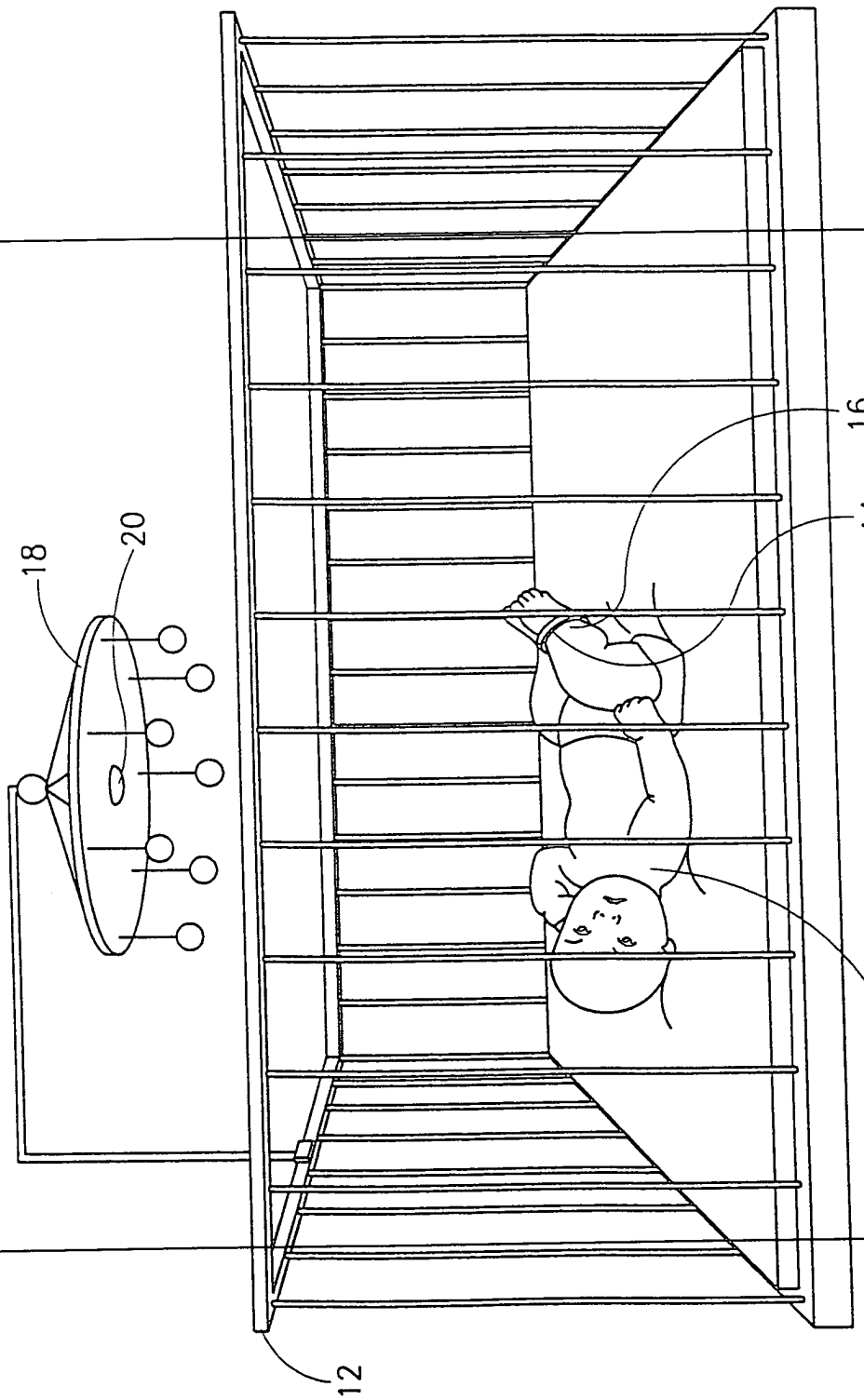


FIG. 1

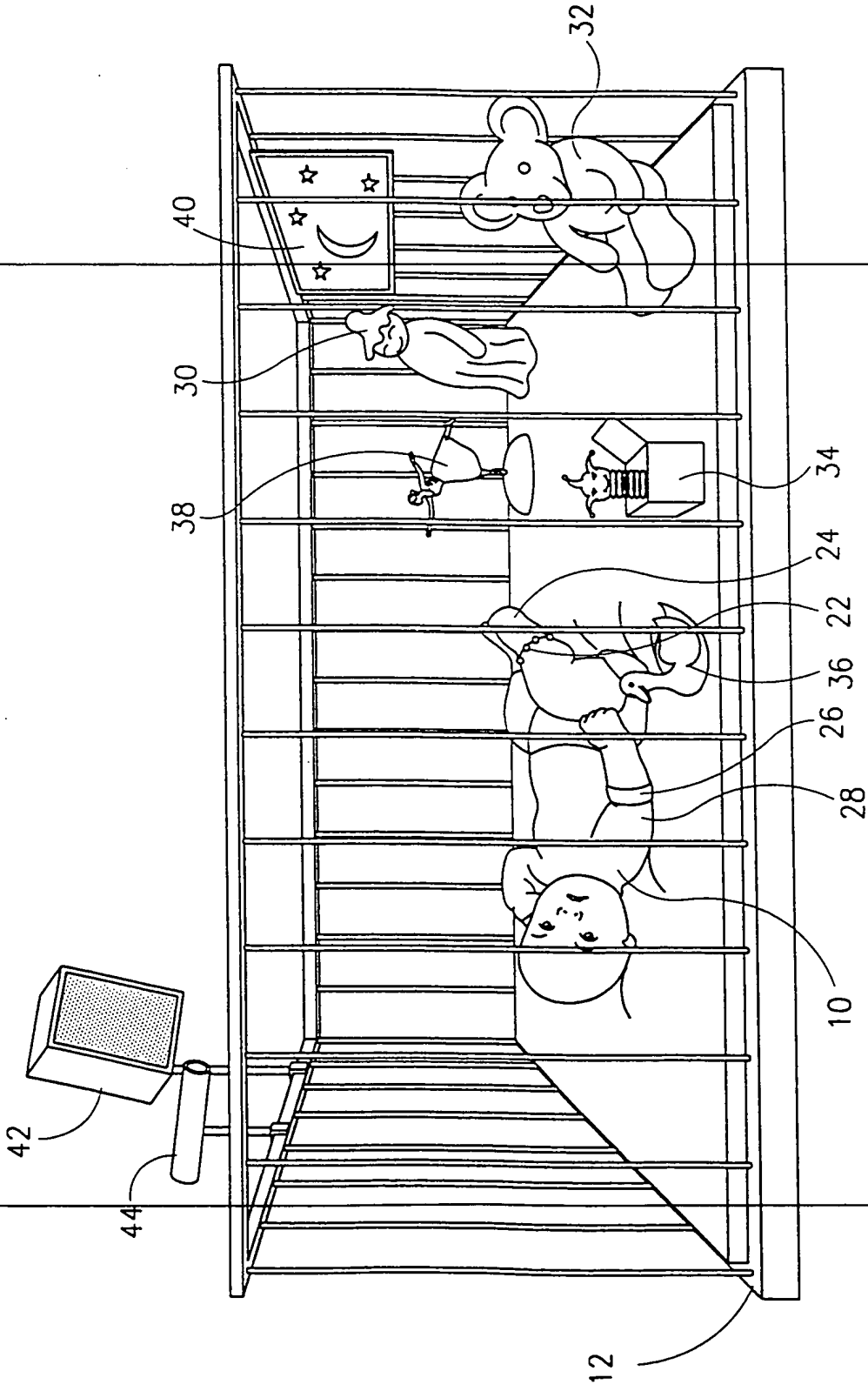


FIG.2

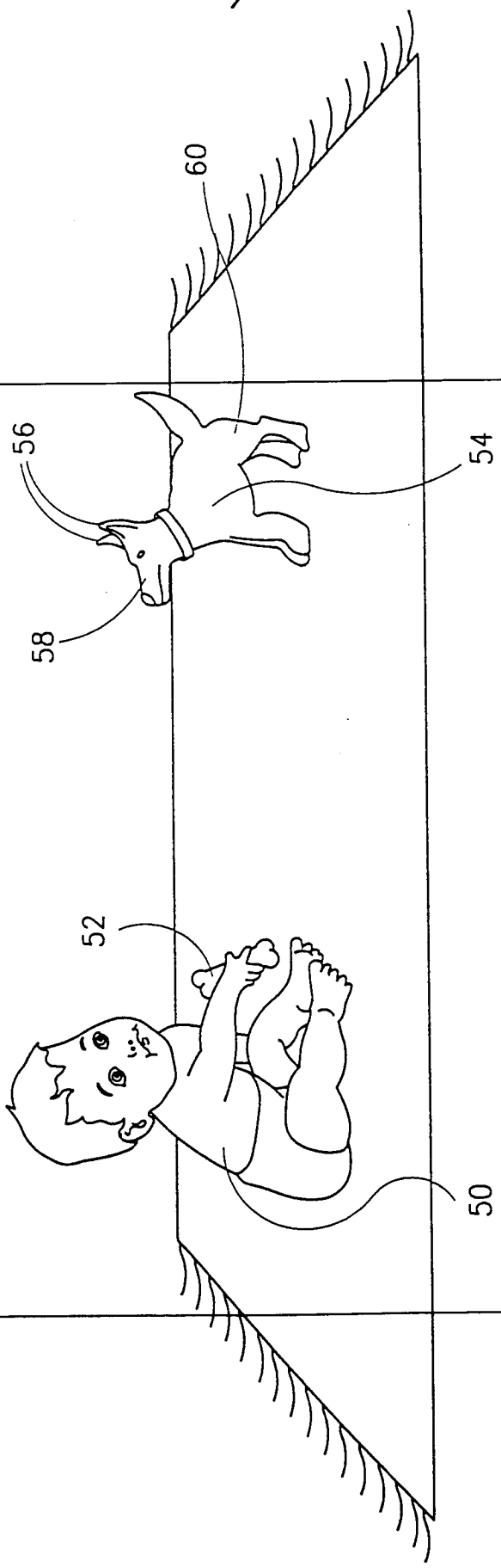


FIG.3

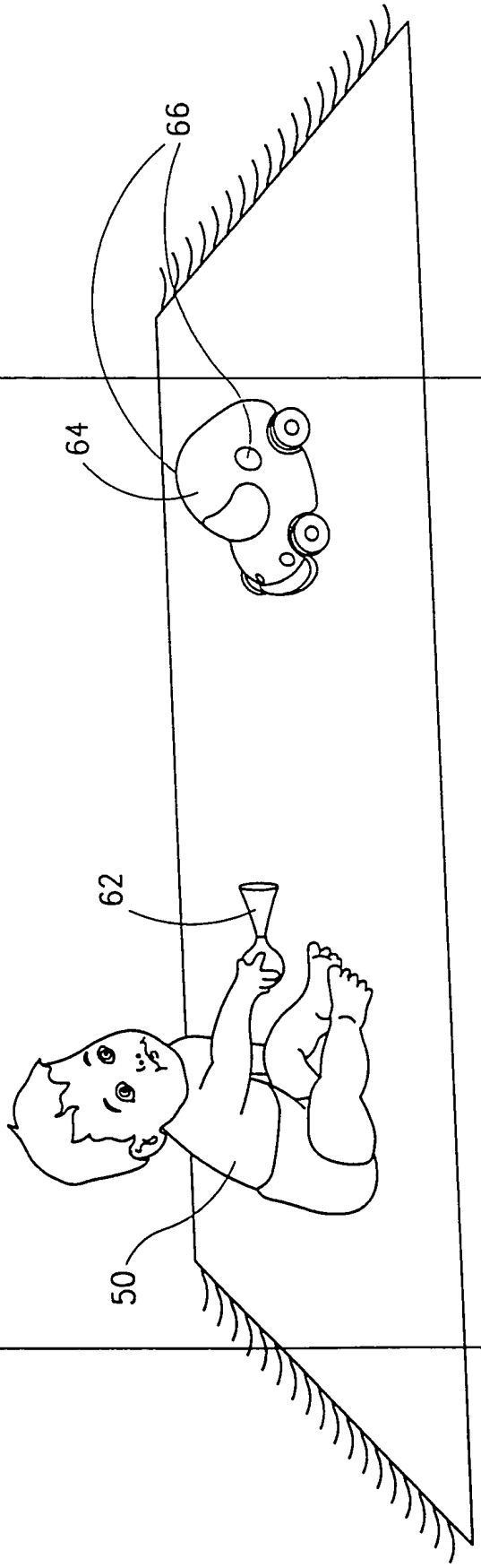


FIG.4

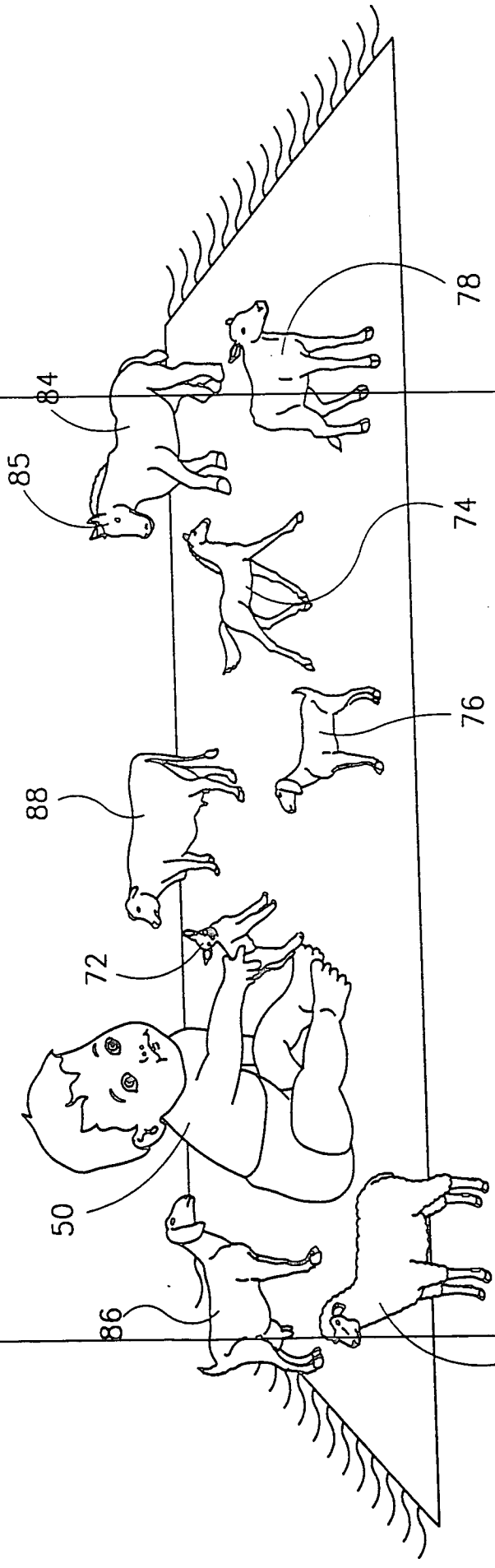


FIG.5

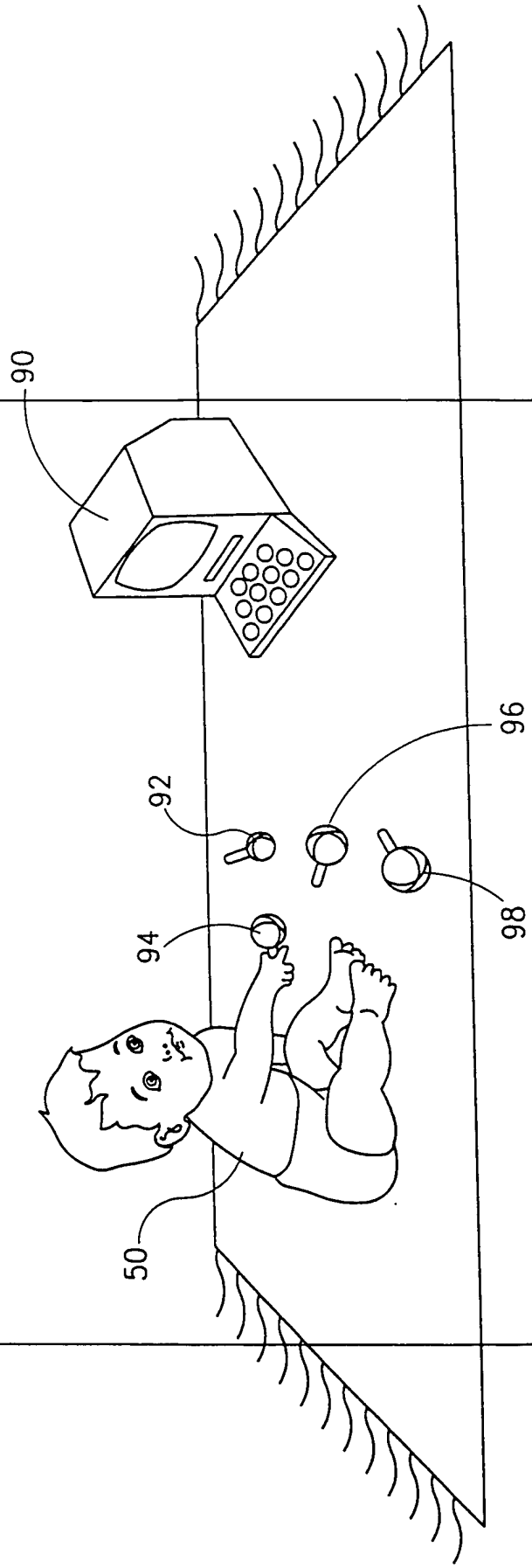


FIG.6

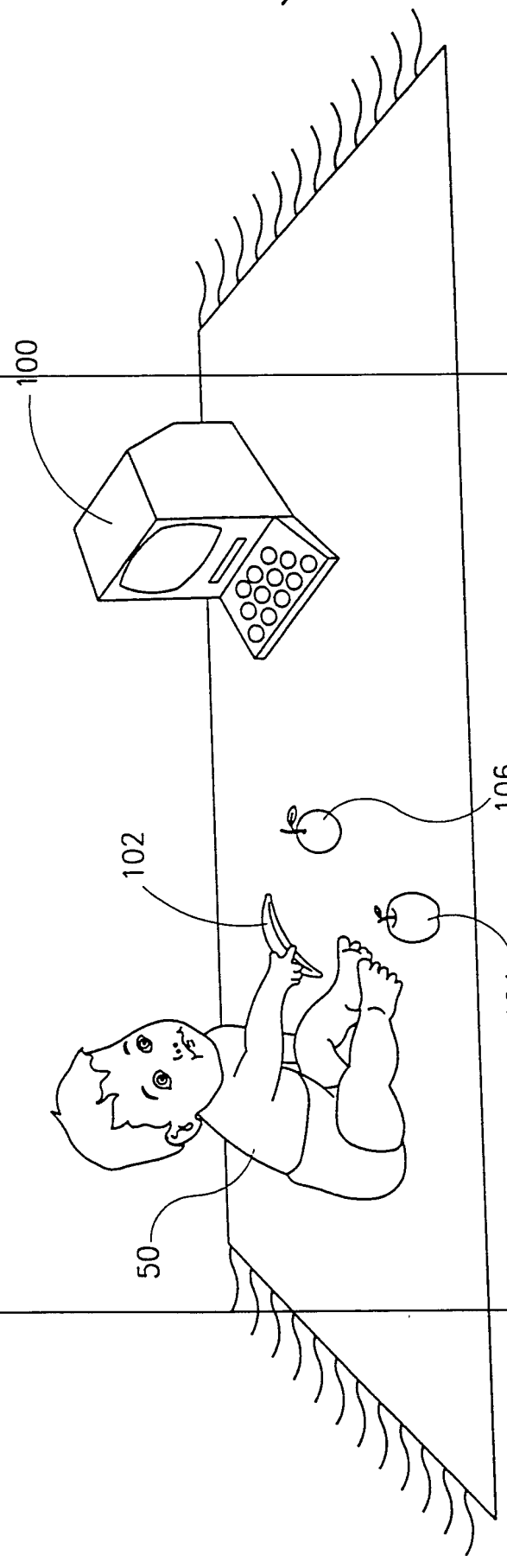


FIG.7

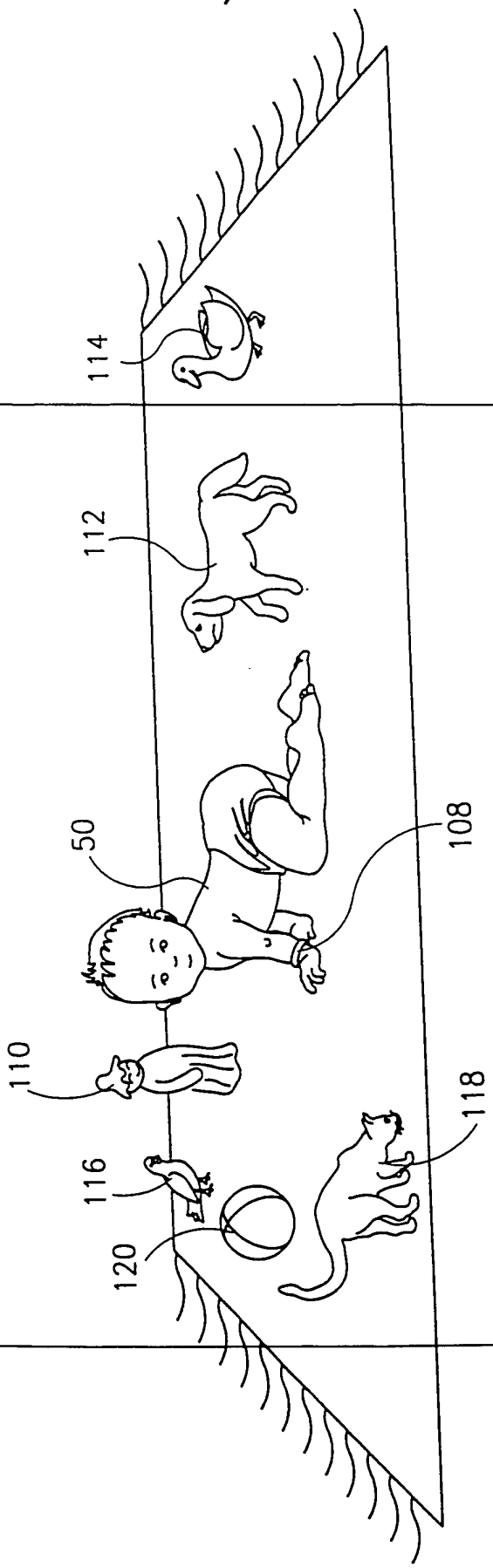


FIG.8

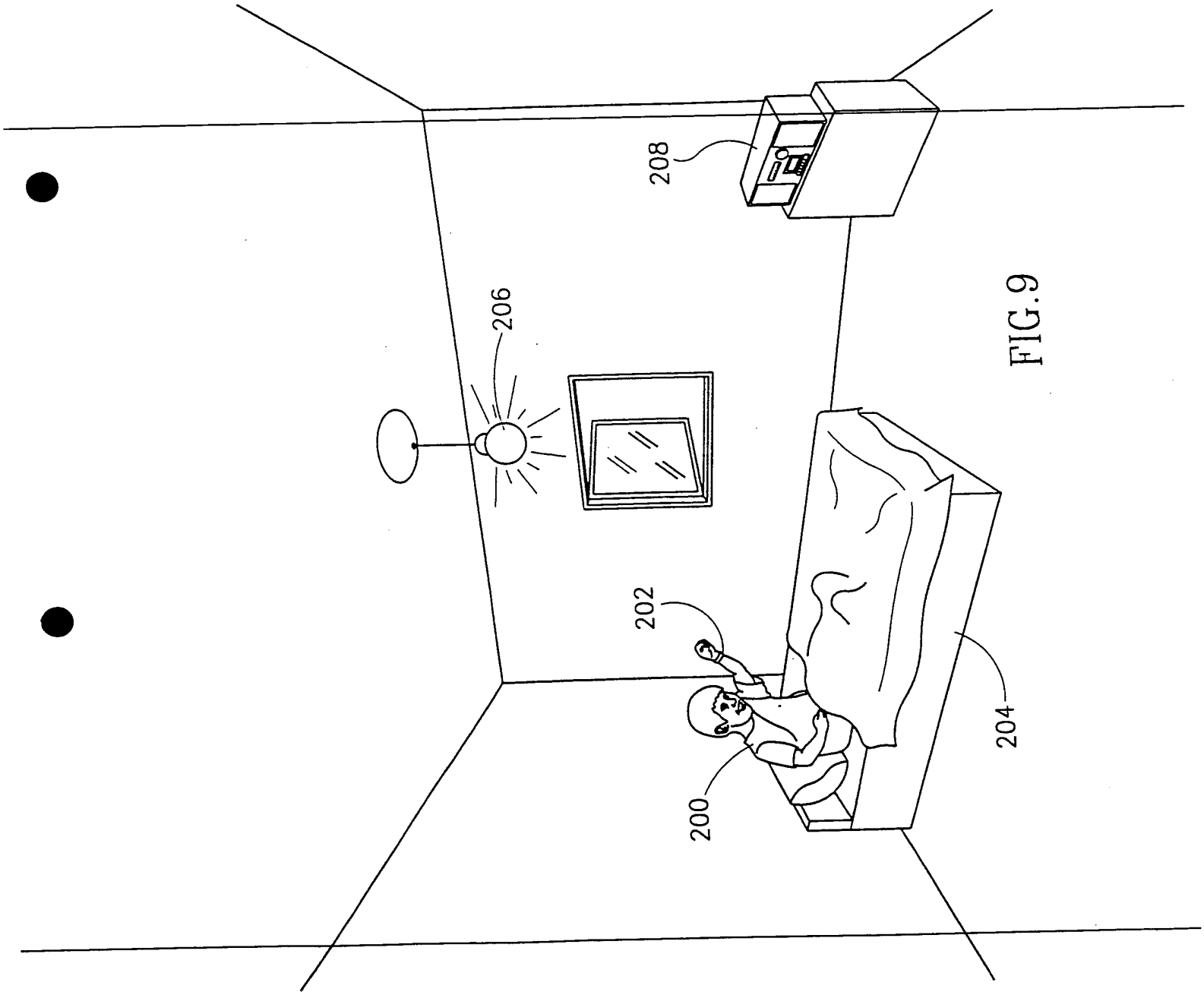


FIG.9

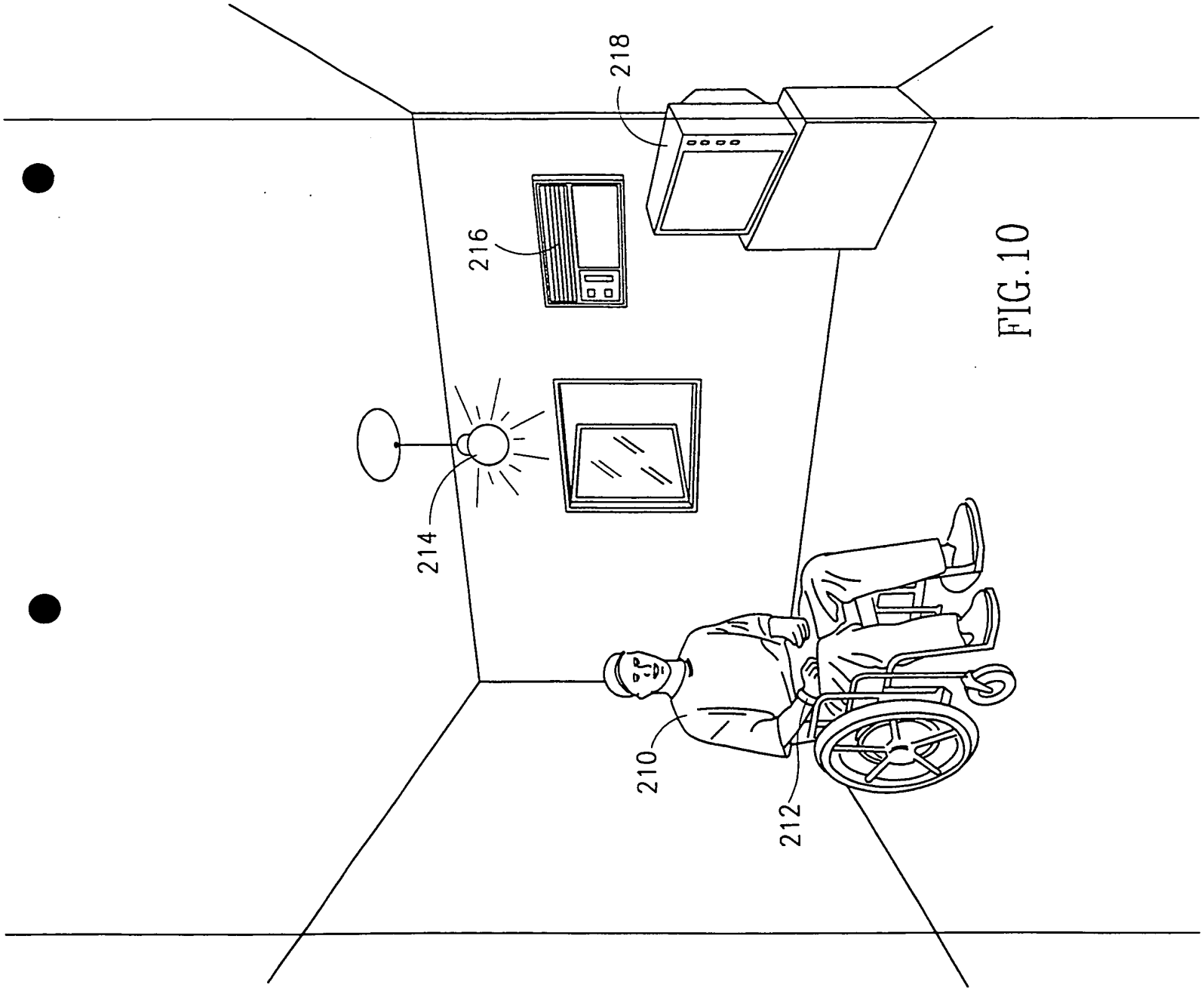
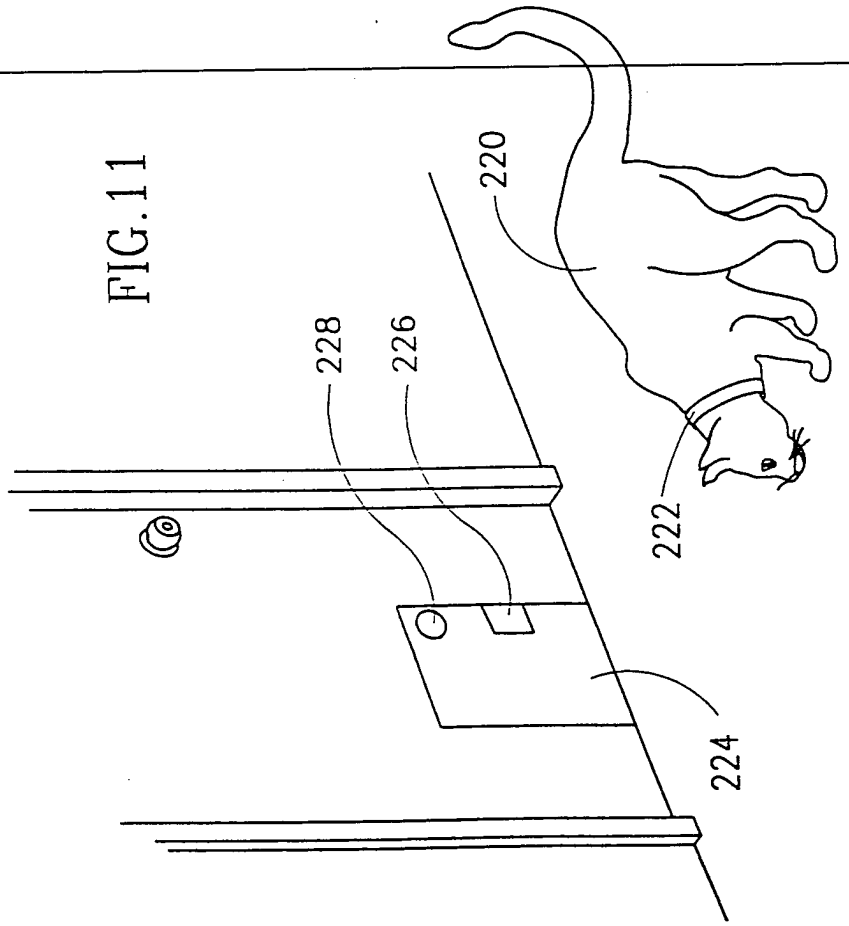


FIG.10

FIG.11



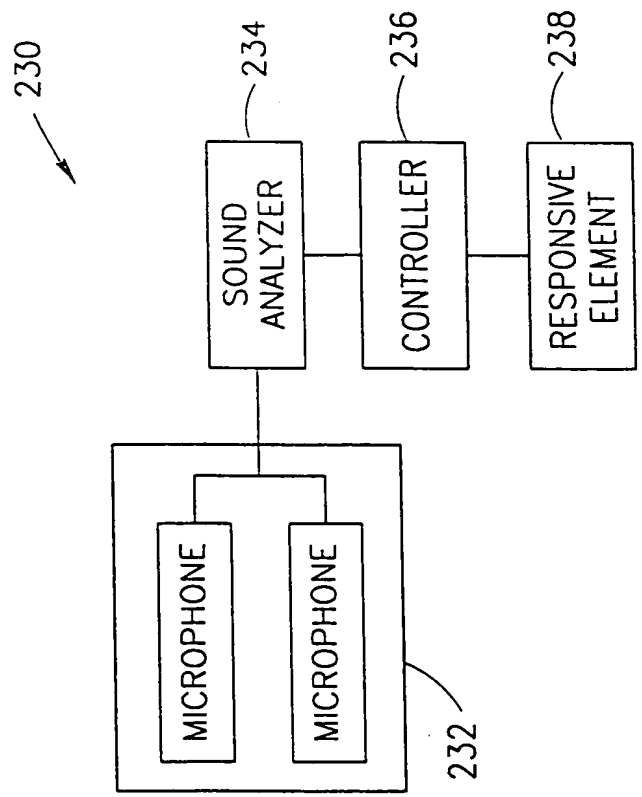

230
234
236
238
SOUND ANALYZER
CONTROLLER
RESPONSIVE ELEMENT
MICROPHONE
MICROPHONE
232

FIG.12